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L. DUDLEY STAMP, B.A., D.Sc., F.R.G.S.

Sir Ernest Cassel Reader in Economic Geography, University of London



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PREFACE

THIS book is the first of the three parts of my Smaller World Geography and is intended for the first of a three years' course in a Senior School or in the lower forms of a Secondary School. As explained in the Preface to the whole book, I have said to myself in writing these books, what ought a boy or girl in any walk of life to know in order to realise that our modern civilisation in this country depends upon the proper utilisation of the resources of the whole world? On the progress and prosperity of each of its countries? This book lays the foundation by considering the basis of geography, the great regions of the world and their relationship to the life of man. In the two other books a modicum of information is conveyed on each of the countries of the world to make intelligible the news conveyed to us in the daily press.

As one of our leading business men said recently, in giving advice on education for business, geography is perhaps the most human of all studies. May we use it in the training of the citizens of the future.

L. D. S.

UNIVERSITY OF LONDON.

December, 1932.

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CONTENTS

SECTION I	25931	PAGE
WHY SHOULD WE LEARN GEOGRAPHY ?		1
SECTION II		
FINDING OUT WHERE WE LIVE .		7
SECTION III		
THE SURFACE OF THE GROUND .		24
SECTION IV		
UNDER THE GROUND .		46
SECTION V		
WATCHING THE WEATHER		60
SECTION VI		
THE REGIONS OF THE WORLD .		85
The Regions of the Hot, Wet Forests +		86
The Tropical Forests and Tropical Grasslands		95
The Tropical Monsoon Lands . . .		102
Warm Temperate Lands		109
The Mediterranean Lands .		114
The Hot Deserts .		119
Cool Temperate Regions .		123
The Temperate Grassland Regions		127
The Temperate Deserts ~		131
The Cool Temperate Regions of the East Coasts +		132
The Cold Temperate Regions + <u>coniferous forest</u>		133
The Tundra Region +		139
QUESTIONS		142

SECTION I

WHY SHOULD WE LEARN GEOGRAPHY?

How did you get to school this morning? Probably you walked, if it is not too far, but some of you may have come by motor bus or by other means if it is a long way from your home to school. At what time did you start? Did you allow five minutes to get here, or did you allow twenty minutes? The answer to that question of course depends again on how far it is from your home to the school. The things we do every day must depend very largely on where we live, and indeed on the exact position of our homes and of the places to which we have to go. It is just the same with the life of whole villages and towns, and even of countries. What they do—their activities—depends very largely on where they are situated. The great ports which surround this country could not have developed if they had been situated inland away from the sea, or from the great river mouths. Similarly with countries. Many of their activities depend upon where they are situated. In the early months of the year we can buy in our shops bunches of flowers which have been grown and cut in the south of France, where the winters are warmer than in England. Those flowers can be cut and sent to us because it does not take more than twenty-four hours for them to get to us in England. But although it would be possible for far-away New Zealand, 12,000 miles away from us, to grow such flowers, the position of New Zealand in relation to the position of the British Isles makes it impossible for New Zealand to send us flowers. So one of the things we always have to consider in geography is the importance of position.

Could you describe the town or village in which you

live? Just think for a moment about it, and then say whether all the streets are level and flat or whether some of them go uphill and downhill. Then think, too, about the roads that you know—how they have to curve, perhaps to avoid a hill, or perhaps to avoid a wet place, or perhaps to go to some point where a bridge has been built across a river. The more you think about these things the more you will see that our everyday life is affected by the surface of the ground, whether the surface of the ground is flat or hilly and whether there are streams and rivers running across the surface, or here and there large ponds or marshes. No doubt your own home town or village has been built in the particular place where it is for some special reason. It may be at a meeting place of roads where there are easy ways to the surrounding towns, or it may have been built originally where the people could easily get water, for in the days of long ago there were no water companies who kindly laid down pipes and brought the water to the peoples' houses. If you have not yourself been to mountainous countries you have at least seen pictures of those countries. On those mountains with their steep slopes, sometimes, it may be, covered with snow, there are very few houses, perhaps no houses at all. The towns and villages are all on the lower ground where men can cultivate the fields. Even in our own islands there are eight times as many people in the comparatively small Midland Valley of Scotland as there are in the whole of the Scottish Highlands. You will see from these examples that the surface of the ground, or, as we say, the physical features of a country, have a great deal to do with the life of man.

But what happens under the ground? Sometimes we can see a brick pit or a quarry which shows that underneath the soil there is clay or chalk or some other substance. On this often depends what can be grown on the soil itself. Then many of us live in mining towns or villages where there is coal underground, and it is really because of that coal that the town has grown up where we find it. So in

geography we learn just a little about what lies under the surface of the ground because, especially where there are important minerals found, the structure of the earth, or its geology, has an important influence on the lives of men.

Now let us think about the clothes you are wearing. When you got up this morning did you glance out of the window to see what sort of weather it was to-day ? Perhaps it was raining and you thought to yourself ' I shall have to wear my mackintosh to school to-day ' Lots of the little things which we have to think about every day depend upon the weather. You all wear warmer clothes in the winter than you do in the summer, for example. Then just think how miserable it would be in the winter time if we did not have at home a nice fire to warm us, yet there are countries where it is so warm all the year round that the people build their houses without any fireplaces at all, and so you see that the builders in this country have to think about the weather. They think about the weather, too, when they are building the roof. They have to make the roof slope so that when the rain falls the water will run off and will not soak into the rooms and make them wet, but in many parts of the world it is so dry that the houses can be built with flat roofs. Indeed, the rainfall is sometimes so precious that a man carefully collects all that falls on the roof of his house. So we see there are many reasons why in geography we must watch the weather. We shall learn later that the average or normal condition of the weather forms **climate**.

But there are other less direct ways in which the weather affects the lives of men. Just think of most of the trees in this country and the way in which they lose their leaves in the autumn. They are bare and apparently dead in the winter, and then in the spring time they get their new green covering again. This is because the trees in this country take a long rest during the winter, but there are many parts of the world where the trees are green all the year round and do not have a winter rest, because it is so hot and moist that there really is no winter at all.

Then again many of you at home have a garden, or perhaps your father has an allotment. Just think for a minute and make a list of the things which you can grow. There are cabbages and cauliflowers, peas and beans, potatoes and beetroots, and many other vegetables. Perhaps you have some fruit trees, apples or pears or cherries or plums. All these things we can grow in our country because the weather or climate is suitable for them. But how many of you have seen an orange tree with oranges growing, or a banana palm with its bunches of bananas? You have not seen them growing in this country because again the weather or climate is not suitable. It is not warm enough for these plants. So we see that it is necessary in geography to learn something about the plants of a country, or the vegetation, because the plant life ^{is} ~~has~~ a very important effect on the activities of man.

In the same way there are the animals. We could not keep cows to give us milk if there were not green grass or other food for them to feed upon. Even the very small animal life is often very important to man. We are lucky in this country. Sometimes we get bitten by midges or mosquitoes in the summer, but we do not have mosquitoes that carry with them terrible diseases, in some countries of the world the life of man is made almost impossible by the immense number of dangerous insects.

We have now learnt of the different geographical factors which help to make up the background of our lives, or, to use a longer word, to form the **physical environment** in which man lives. All these different factors work together to determine our daily life. We are influenced in some way by each of them, and so we can show by a little diagram, such as the one given below, the way in which factors work together to influence our lives.

But man is a thinking animal, and when he has taken thought he is often able to change some of these factors of his environment. Let us look for a minute at some of the ways in which we can do this. We cannot alter the fact of position: we cannot alter the fact, for example,

that London is in England on one side of the Atlantic Ocean, and that New York is in the United States on the other side of the Atlantic, 1,000 miles away. But we can do many things to overcome the disadvantages of position. We have telegraphs and telephones so that a man in London may speak to a friend in New York. We have swift steamships which cover the distance much more rapidly than did the old sailing ships in days gone by. On land we have fast trains and fast motor buses. I lived for some years of my life where there are no real roads and where the only means of travelling from one place to another was by a cart drawn by two slow bullocks. These carts were

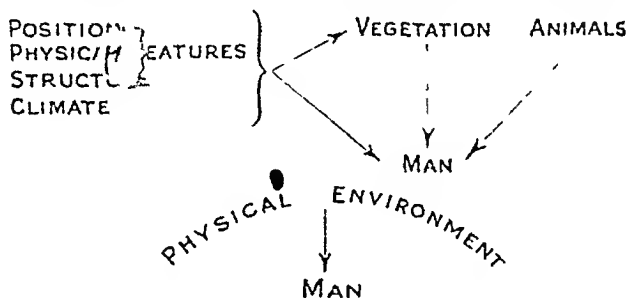


FIG. 1 —The geographical factors

not able to travel more than two miles an hour, and did not go more than fifteen miles in a day, so if I wanted to go on a journey of sixty miles it took me four days, yet in this country we should be able to take an express train and go the whole distance in only one hour. Man therefore cannot change position, but he can do a great deal to overcome some of the disadvantages of position. Man cannot do very much to alter the physical features of a country. If a country is very mountainous he cannot make it into a plain, but if there is a great stretch of flat marshy land which is not of very much use, man can carefully drain it and turn it into valuable farm land. In the heart of the little country of Holland there is a broad

shallow arm of the sea called the Zunder Zee. The Dutch have decided to turn this shallow sea into dry land by building banks round it and then pumping out the water. Sometimes therefore, man can do quite a lot to alter the physical features of a country. He can construct railway tunnels and so make travel which would otherwise be very difficult much more simple. When it comes to altering the structure of the earth, then very little indeed can be done. We cannot place a coalfield where a coalfield has not already been placed by nature. We can do a little, perhaps, in the way of improving a poor soil by adding manure to it, but this really only affects the surface of the earth and not the underlying structure. Then, too, what can we do to alter the effect of weather or climate? (Climate is simply the average or normal state of the weather.) Well, we can protect ourselves against it, but we cannot stop it from raining, and we cannot bring the rain sometimes when we want it. We can make our houses warm to counteract the cold, and we can sometimes grow plants in greenhouses and keep them warm there, but if it is too hot we still know very little about how to make it cooler. It is true we have learnt how to keep meat fresh by freezing it or cooling it, and by this means we can bring fresh meat from distant parts of the earth. Similarly too we can bring such things as fresh fruit. We cannot, then, do very much to alter the weather or climate, but we can do quite a lot to counteract its effects. When it comes to man's influence on vegetation, quite a lot can be done. He can cut down the forests or the grass which grows naturally, and can plant other trees or plants in the place of those which were growing wild. In a country like England there is now very very little left of the natural vegetation of the country, the whole surface has been altered by the work of man. So it is too, with the animal life. We can kill off many of the wild animals, and we can bring from one country to another different domestic animals. The English sheep of different breeds are now found throughout Australia and New Zealand and many

other parts of the world, many thousands of miles away from this country. Man has learnt a great deal about how to combat the smaller animal life—how to get rid of some of the insect plagues and how to prevent the spread of disease. Sixty years ago when the French tried to construct the Panama Canal thousands of workers were killed by a terrible illness called yellow fever. Now yellow fever has been conquered by man, and it is almost non-existent in the Panama Canal Zone. Let us now redraw our little

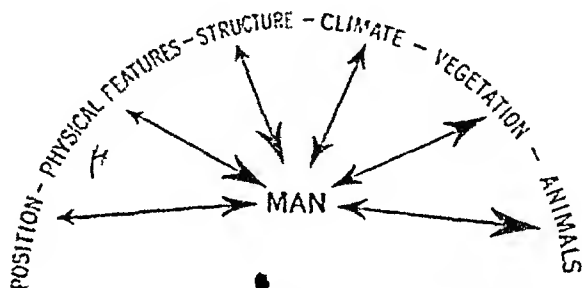


FIG. 2.—The influence of man on the geographical factors

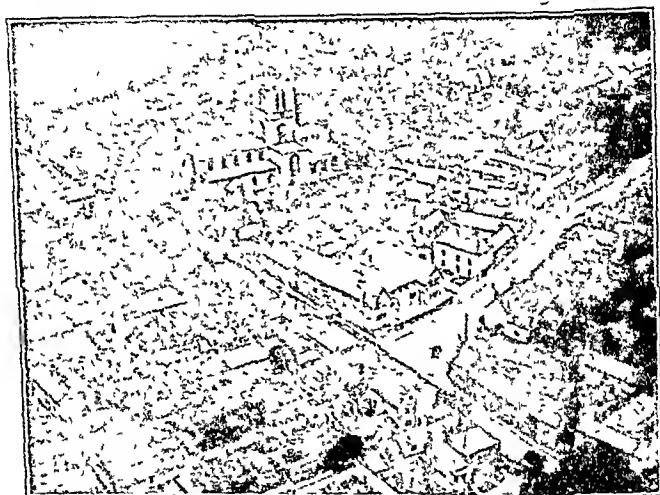
diagram and show by the arrows with barbs at each end, how man is not only affected by these different factors of his environment, but also how he is able to exert his influence on them. In the chapters which follow we are going to learn a little more about each of these different factors by which we are surrounded, and see something of the way in which they affect our everyday lives.

SECTION II

FINDING OUT WHERE WE LIVE

PERHAPS you will say at once, "Of course we know where we live. What is there to find out?" But suppose you have a friend in Canada or Australia who wants to send

you a letter. He has to put first of all your name and then the name or number of your house, the street and the town, then perhaps the county, and at the bottom of the envelope England or Great Britain. You will see that he has tried to express exactly where you live so that the postmen and the post offices understand it and will be able to send the letter so that it reaches you. But there are other ways in which we can express position. The most



[Photo Aerofilms, Ltd]

FIG. 3—View taken from an aeroplane looking forward. It shows a village at the junction of two roads

important of all these ways is by means of a map. We often talk about getting a bird's-eye view of something, and that is really what a map is, it is a bird's-eye view of the country, for we think of a bird flying high up in the sky and looking downwards upon the earth. But it is not really necessary to imagine what a bird can see, because we can ourselves go up in an aeroplane and look down upon the earth. If, when we are up in the aeroplane, we

look not directly underneath us but slightly forward, we shall get a view of the country such as is shown in Fig. 3. Such a picture certainly gives us a very clear idea of the country, and we shall in many places in this book use similar pictures that have been taken from aeroplanes. We see the buildings very clearly because we can see both the walls of the buildings and the roofs at the same time. But if we look directly underneath us we shall only be able to see the roofs of the houses, for the walls will be hidden. If we take a photograph from the air with the camera pointing directly downwards, we shall get such a photograph as is shown in Fig. 4. Now look carefully at that photograph. You will see that there are numerous dark blobs. They are the leafy tops of large trees and, unfortunately, they often hide what is underneath them. Suppose you have a line of trees along the side of a roadway: the tops of the trees may be so large that they will hide the road altogether: but really the road is more important than the trees. If we could imagine the trees cut down, the road would then be clearly visible, and here we have what is really the chief difference between a map and an aeroplane photograph. The photograph shows everything as it is seen from above but when we make a map we can cut out the things that we think are not important, such as the tops of the trees, and we can leave only those things, such as the roads and buildings, which we consider are important. Now look carefully at Fig. 5 and compare it with the last, and you will see the difference between the map and the photograph of the same piece of country. You will notice that the map shows the roads, the buildings, and the divisions between the fields, but it is a map of only a very small piece of country.

If we could imagine our aeroplane going higher and higher, we should soon reach a level from which it would be impossible to see the individual fields or the individual houses. A mass of houses together making a village or a town would appear as a blur. We might still be able to see the lines running between the villages representing

the railway lines or the roads, and we could make another map this time showing railways, roads, villages, and towns, but not the separate houses or the fields. Most aeroplanes do not travel at a greater height than 10,000 or 12,000 feet but suppose you imagine that an aeroplane could go very much higher still and yet it was possible to see the

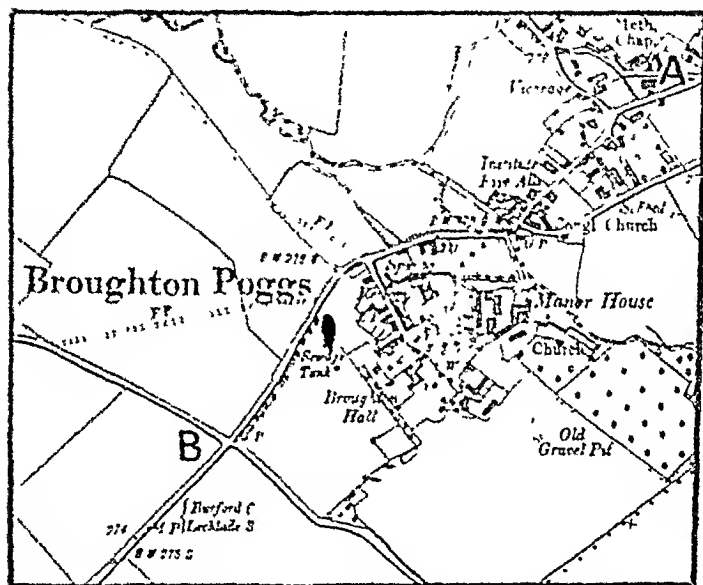


[Photo Aerofilms, Ltd

FIG 4—A view taken from an aeroplane looking directly downwards, showing a village in the country.

surface of the earth. We might look downwards and see just the bare outline of our country, the British Isles, standing out in the middle of the sea, and giving us a shape such as is shown in Fig 6. From such a height we should not be able to see roads or villages, perhaps not even be able to distinguish the largest towns, but we should still be able to say to ourselves "that is the outline

of the British Isles," and we know that in the British Isles there are a number of important towns and we could say, "Although we cannot see them clearly let us mark them by dots and give them their names." And so we should make a map of the British Isles. So when you study your atlas or the maps that are in this book, try and think of them as having been made in this way. Try and picture



[Based upon Ordnance Survey Map, with the sanction of the Controller of H. M. Stationery Office.]

FIG. 5—A map of the same area as the last figure.

yourself high up in the air looking down on the country, and then just putting on the outline which you can see what you know to be the important things.

Maps which only show a small piece of country are called large scale maps. Fig. 5 is an example of a large scale map, and we can now find out what we mean by the scale of a map. Look again at Fig. 4. If we live in that part

th country we know by measuring on the ground that the distance from point A, the spire of the church, to the point B, the crossroads is exactly half a mile in a straight line. When we look at Fig. 5, which is the map of the same area we find that on the map the distance between these same two points is exactly three inches, and so we can say that three inches on the map represents half a



FIG 6

mile on the ground, or that six inches on the map represents one mile on the ground; and so we say that the scale of the map is six inches to one mile. In the British Isles there is a Government Department called the Ordnance Survey which has its head offices at Southampton. The Ordnance Survey issues many different maps of the British Isles. There is a series covering the

whole of the islands on the scale of six inches to the mile, and Fig. 5 is an example of one of these maps. Another very important series issued by the Ordnance Survey is the series on the scale of one inch to one mile. You have an example of one of these maps in Fig. 7. If we are looking down at a piece of country from an aeroplane it is not always easy to distinguish which is a road and which is a railway, and perhaps even which is a canal or which is a road, and so when we are drawing a map we have to make a difference between these things. In order to make the difference stand out clearly we employ what are called "conventional signs," and so underneath Fig. 7 you have a number of conventional signs which are used on those maps of the scale of one inch to the mile. Study these signs carefully and then try and find on the piece of map a church, a footpath, a canal, and various other things.

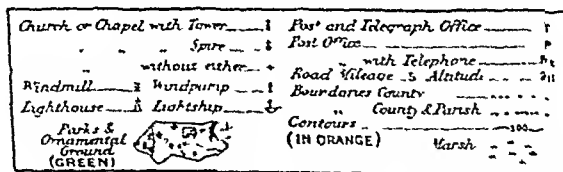
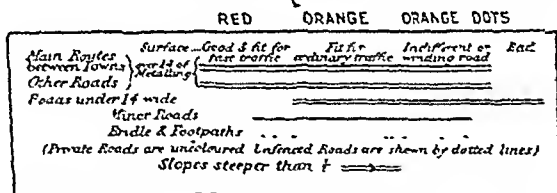
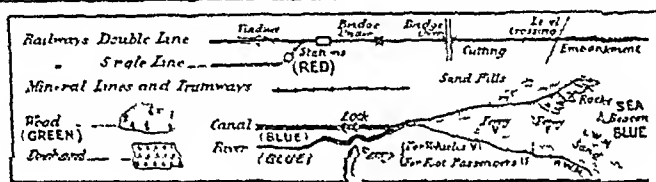
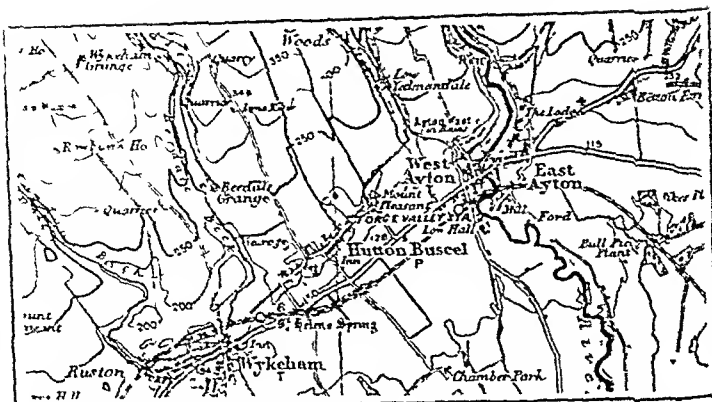
But in our atlases and books we often want to show certain things about a whole country on one small map, and so we have what are called small scale maps, and on these one inch may represent even hundreds of miles. Look at the small outline of the British Isles (Fig. 6). It is 350 miles from London to Glasgow, two points which are marked on the map, and yet you see that the distance between those two points on the map is only $1\frac{3}{4}$ inches, and we can work out from this that the scale of this map is 200 miles to the inch.

But there is another way of expressing the scale of a map. Let us suppose that one inch on the map represents one mile on the ground. You can then work out this sum, remembering that there are twelve inches in a foot, three feet in a yard, and 1,760 yards in a mile

If one inch represents one mile—
 then one inch represents 1,760 yards,
 one inch represents $1,760 \times 3 = 5,280$ feet,
 \therefore one inch represents $1,760 \times 3 \times 12 = 63,360$ inches

We have now found out that one inch on the map represents 63,360 inches on the ground, and we say that

THE REGIONS OF THE WORLD



(Ordnance Survey, One inch Popular Edition by permission of the Controller of H. M. Stationery Office)

FIG. 7.—Part of a map on the scale of one inch to one mile, and explanations of the signs used

is the "Representative Fraction" of the map. Now work out what is the Representative Fraction, or R.F., of a map on the scale of six inches to one mile, and a map on the scale of one inch to a hundred miles

We have now learnt one way of finding out where we live. It is by reading a map. If we know that our home is ten miles from a big town we can find that big town marked on the map, and then by means of the scale of the map can work out exactly where our home is situated by following along in the right direction. You will learn later how a map can teach us a great many other things about the character of a country and the different ways in which we can show hills and valleys on a map.

A little while ago we imagined ourselves going up so high in an aeroplane that we could see the whole of the outline of the British Isles

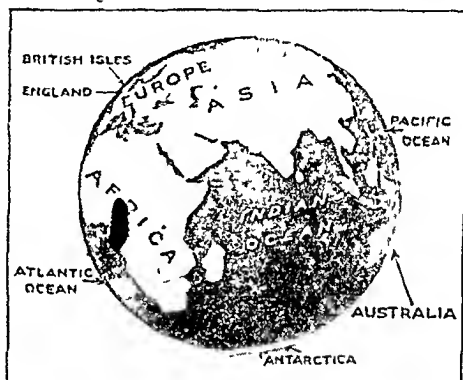


FIG. 8 —The Old World

at once. Of course it is not possible to do this. But let us for a moment imagine that we could go up still higher in our aeroplane, so as to get right away from the earth. We should see then that the earth is really a huge ball floating in space. We might be able to see just the outline of the great masses of land and the great oceans which separate them, and we might get a view which looks rather like Fig. 8. Sometimes we talk about the men in the moon, though there are no men in the moon, but if we could imagine ourselves on the surface of the moon, the earth would look to us rather as it does in this picture. I have put on it some

of the names of the great masses of land, or continents as they are called. Of course we should only be able to see one side of the earth at once. But if we could turn it round and see the other side we should get a picture rather like that shown in Fig 9. You will see from these two pictures that there are really seven great pieces of land, or continents—the continents of North America and South America, which make up the New World, and the three continents which make up the Old World—Europe, Asia, Africa. Then there is Australia and another big piece of land to the south, the continent of Antarctica. Now notice

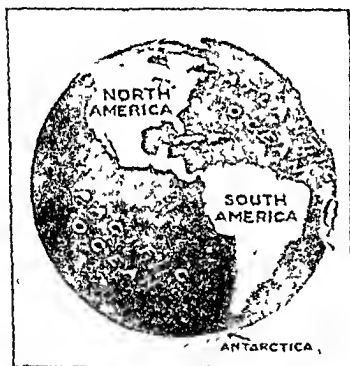


FIG 9 —The New World

the great masses of water or oceans which separate the land masses.

No doubt you have at school a globe, which is really a small model of the earth as it actually is, but no doubt if you think about it you will say "the earth cannot really be like that because the oceans are very deep, and on the surface of the land

there are very high mountains and hills." Here we must remember something about the size of the earth. It is nearly 8,000 miles from one side of the earth to the other, or, as we say, the diameter of the earth is roughly 8,000 miles. But the deepest part of the ocean is only a little over six miles deep, and the highest mountain on the earth is not quite six miles high, and you will find that if you put a tiny grain of sand on your school globe, that represents in its proper size the highest mountain of the earth. Now, how can we find the position of where we live on the surface of the school globe? Well, of course

we can look for our country and probably find its name and see roughly where our home is, but suppose you want to know the position of a ship which is crossing the Pacific Ocean. It might be thousands of miles from any land, and what would happen if that ship had an accident, its engine broke down, and it was unable to go on? With the help of modern invention it could send out a wireless message asking for help. But what

would be the use of saying, "I am 5,000 miles from San Francisco"? It would be impossible for any other ship to find it without some further direction. And so we have another very important way of marking position on the surface of the globe and on a map. We shall learn later that the earth is not still, but turns round once in every day (if it did not do this we should not

have day and night); and then once a year the earth moves right that there is a sun. Now when the earth turns round, it rotates on its axis, once a day. We must see what we mean by the word axis. Look again at the school globe, or if you cannot do that, at Fig. 10. You will find that the earth turns round in such a way that there are two points which really do not move.

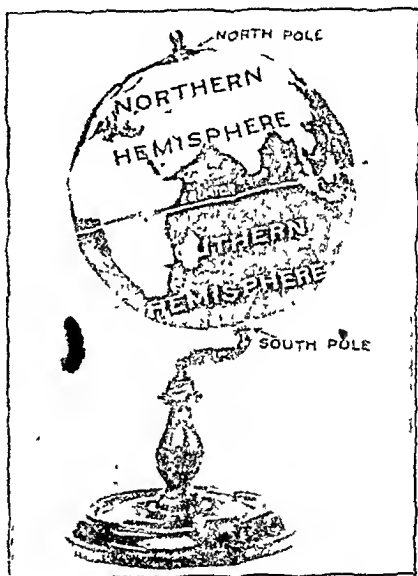


FIG. 10.—The Globe showing N and S Poles

These two points are the North and South Poles, and the axis of the earth is an imaginary line stretching through the centre of the earth between these two points. You can hold a tennis ball between your thumb and your first finger and then twist it round, and you can imagine your thumb is touching the South Pole of the tennis ball and your first finger is touching the North Pole of the tennis ball, and you will see roughly how the earth turns round. Now, running round the centre of the earth, half-way between the North and South Poles, we have an imaginary line. This imaginary line is called the Equator, and you can see that it divides the earth into two

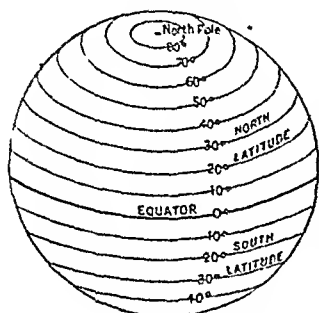


FIG. 11.—Lines of latitude

halves, two halves which, to use a long Latin name, are half spheres or hemispheres. We have the Northern Hemisphere and the Southern Hemisphere. Now try and imagine yourself walking, if it were possible, from the North Pole to the Equator. You could divide the distance that you have to cover into a number of equal parts. You could

divide it into four parts or six parts, but for certain reasons which we shall see presently, the distance between the North Pole and the Equator or between the South Pole and the Equator has been divided into ninety divisions or ninety degrees. These are called degrees of latitude. You can see that when you have walked ten degrees from the North Pole you are at the highest small circle round the North Pole ten degrees high, and so we can divide up the sphere on it, as you see has been done in Fig. 11. And the Equator 0. we can start numbering these degrees of latitude away from the Equator on either side, and you will see that on that

figure has been marked 10 degrees north latitude, 20 degrees north latitude, and then again the same number of degrees south of the Equator. Now, if we find we have a place which is 52 of these small divisions away from the Equator on the north side of the Equator, or in the Northern Hemisphere, we can say that that place is in 52 degrees north latitude (which we write 52° N), and that expresses absolutely its distance from the Equator. If we know that 1° is roughly equal to sixty-nine miles, we can very easily work out the distance in miles. There is one point we ought to remember here—that is, the earth is not quite a real sphere like a tennis ball. It is very slightly flattened at the North and South Poles, and this results in a degree of latitude being slightly longer near the Poles than it is near the Equator.

Now let us imagine ourselves on the Equator. We can start from one point on the

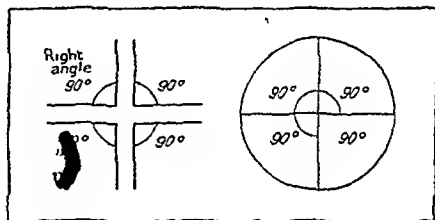


FIG 12

Equator and we can go right round the earth until we come to that point again. We shall have gone round a complete circle, and actually we shall have gone about 25,000 miles. If we could get ships to take us across the ocean and then travel across the land masses it would really be possible to do this. But when people travel round the world they do not as a rule go exactly along the line of the Equator. You all know from your geometry that there are 90° in a right angle, and if you put four right angles together, as in Fig 12, you will of course have four times 90° , that is, 360° . You will see then that a circle contains 360° , and if we walk right round the earth along the line of the Equator, we shall have walked through 360° . That is why we divide the Equator

1 to 60 equal parts, each of which is a degree of longitude. But the first thing is at what point on the Equator should we start? Fortunately most nations of the earth have agreed on a starting point and have drawn a line from the North Pole to the South Pole across the Equator, and passing through a very famous building in London, the Observatory at Greenwich, where there is a very large telescope through which the stars are watched regularly by a staff of men. This line of longitude passing through Greenwich is called longitude 0, or the meridian of Greenwich. Through each of our 360° round the Equator we can draw a similar line passing through the North and

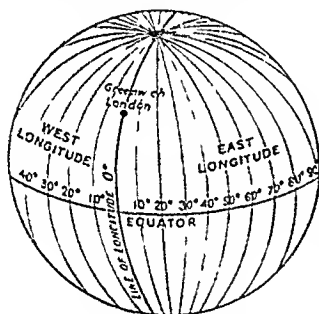


FIG. 13 — Lines of longitude

South Pole and a point on the Equator. Each of these is called a meridian of longitude, and we number the lines of longitude east and west of the lines passing through Greenwich, so that we get 1 up to 180 on one side and 1 up to 180 on the other. And the longitude of 180° is exactly on the opposite side of the earth to the

meridian of Greenwich. In Fig. 13 you see a sphere on which every 10° of longitude has been marked. Now the reason why we divided the distance between the North and South Poles and the Equator into 90° will be quite clear to you, because if we go round the earth from the North Pole across the Equator to the South Pole, then across the Equator the other side to the North Pole, we shall have again passed through a complete circle, that is through 360°. Now let us put the lines of latitude and the lines of longitude on the same drawing of a globe and we get an appearance such as is shown on Fig. 14, and we see at once that we have a way of pointing out

any spot on the earth's surface. If we return now to our ship in distress in the middle of the ocean, that ship can send out a message that it is in latitude 10° north and longitude 165° east and its position can be marked exactly on a globe or a map which has only marked on it lines of latitude and longitude.

Now let us for a moment return to our map. The earth is really a sphere or a globe, but a map is drawn on a flat piece of paper. If you carefully remove the peel from an orange, you will find that you cannot spread that peel

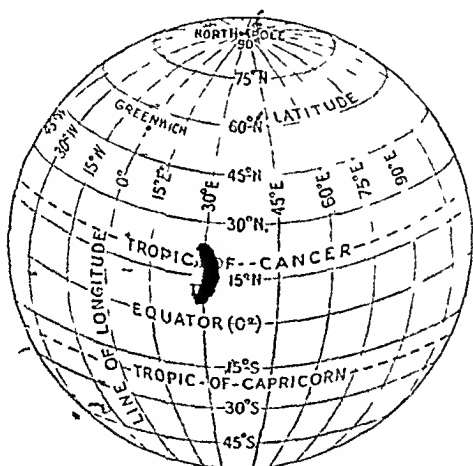


FIG. 14.—Diagram of latitude and longitude

out to make it flat without it splitting all round the edges. So, too, if we try and fit a flat piece of paper round the school globe, we find that we shall have to crumple it up. We cannot, therefore, have a map on a flat piece of paper of a large part of the earth's surface which is really a true picture. We have to employ what are called map projections.

Before we leave this section there are one or two other things which we ought to remember. We have found

out that the earth is a great ball floating in space, the moon is a smaller ball which moves round the earth. The earth and the moon together in their turn move round an enormous ball of gas and flames which is the sun, millions and millions of miles away, actually over 92 million miles away from us, but from which we get heat and light. The light which we get from the moon is really only the reflection of the sun on the moon.

So we see the earth has two important movements: it turns round on its own axis once every day, causing day and night, it moves round the sun once in every year, causing the seasons.

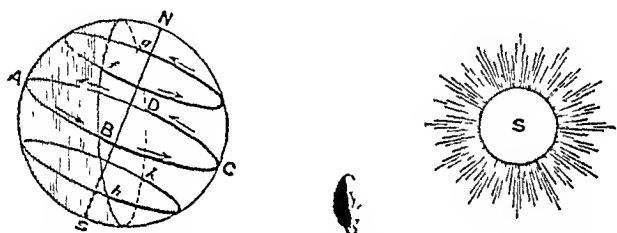


FIG 15—How day and night are caused. The shaded part of the earth (away from the sun's light) represents the night. The arrows show the direction of the earth's rotation.

The earth is so large that to us living on the surface it seems to be fixed. We say the sun rises in the morning and sets in the evening. But really the sun is fixed and it is the earth which moves round on its axis. The sun appears to rise in the east and set in the west, that is because the earth rotates on its axis from *west* to *east*, as the little diagram shows.

Now notice your school globe. You will find the axis of the earth is not placed in an upright position but sloping to one side. We call this the inclination of the earth's axis, and when the earth moves round the sun, which it does once in a year, the earth's axis is always inclined in the same direction. This is very important. Perhaps you

best understand it by imagining the sun to be in the middle of your class-room, and you can then move the globe round the room. You will thus imitate the earth's movement round the sun, but be careful to keep the axis of the earth always inclined in one direction. When the globe is in the position shown in Fig 16, you will be able to find a spot which is directly facing the sun—on which the sun's rays shine vertically. Rotate the earth and you will find a line along which all places come directly under the sun once a day. When this line is as far to the north as it is possible for it to be, we have our midsummer day in England (June 21, called also the summer solstice), for then the sun is shining vertically not so very far south

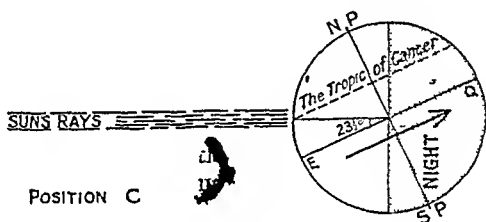


FIG 16

of England, and even to us he appears very "high in the sky." The line traced out on this day by the belt of vertical sun is called the Tropic of Cancer. Notice from Fig. 16 that there is a part of the earth's surface round the South Pole on which the sun does not shine at all at this season of the year. Indeed, all places within the *Antarctic Circle* have one day at least in the year on which the sun never rises. But places around the North Pole have continuous daylight—in the lands of the midnight sun there is no night in the summer.

Now we can find the position when the sun is shining vertically in lands far to the south of the Equator. This is in our winter (when it is summer in Australia and other lands south of the Equator). On December 22 (our mid-

winter or winter solstice) the belt of vertical sun ^{tr}h
out another line—the Tropic of Capricorn—and on ^{the} _{down}

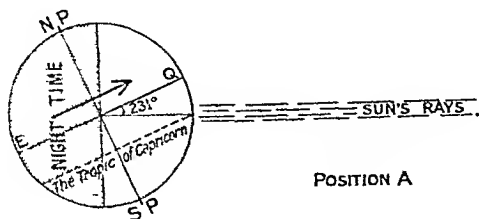


FIG. 17.

it is dark (the sun does not rise) at all places inside the *Arctic Circle*.

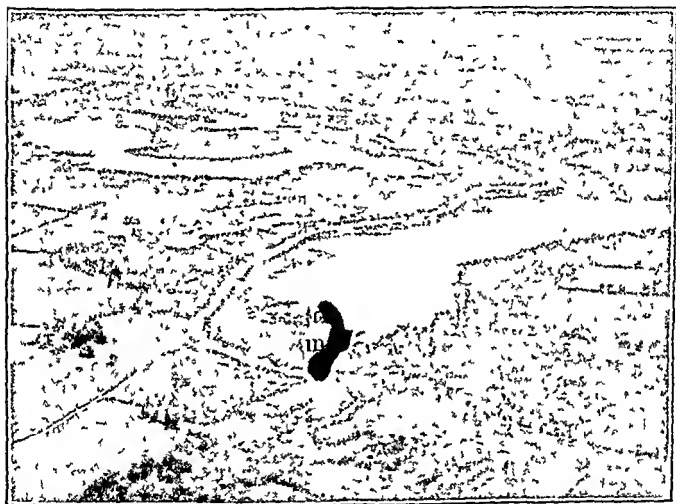
SECTION III

THE SURFACE OF THE GROUND

LET US NOW see what we know about the surface of the land. Wherever we live we know that it is not always the same. There are some places which are flat or level, there are some places which are hilly. Even if we live in the middle of a big city, we can tell this because the roads go slightly uphill. Perhaps many of us have never seen high mountains which rise thousands of feet, but we can all imagine, at least partly, what they look like. It is not difficult to understand also how the surface of the country affects the life of man, for where there is flat land or gently rolling land, it is not difficult to build houses, and so villages and towns arise. On flat land, too, we can easily construct railways and roads. But if you can imagine a land full of giant mountains it would be very difficult indeed to build houses on the mountain sides, and indeed there would be few reasons for building

Here It would not be possible to cultivate the land about, and so we find that mountainous areas have few people, or as we say are thinly inhabited. The flat lands or valley lands often have very many people indeed.

Let us first see how many different kinds of surface we know. First of all there is a plain or very flat country



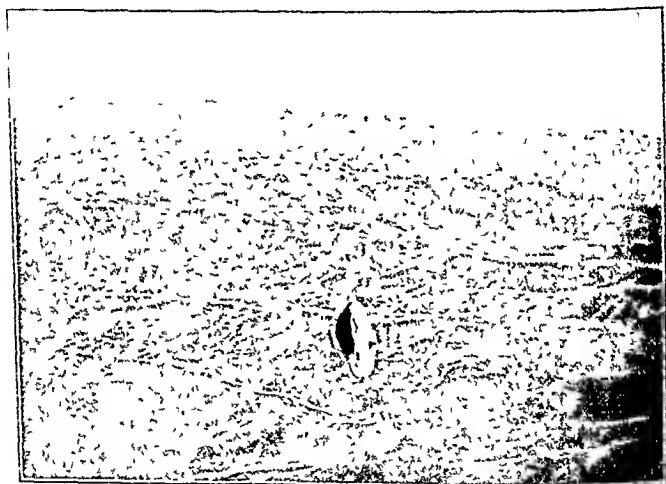
[Photo Central Aerophoto Co., Ltd.]

FIG 18—Photograph, taken from an aeroplane, of a plain, with a river meandering across it, and in places flooding the lower land.

Very often the plain is on either side of a river and, as we shall see presently, is due to the deposition of mud and sand by the river, and so we call it a *river plain*. Some of you may know streams near your own house where there are flat meadows on either side. These meadows often become flooded in the winter months when the stream is full of water, and so they form a flood-plain of a river. But not all plains are quite flat: some of them are

undulating or gently rolling land, such as the great ^{the} which occupy central America

Then we have hills or hilly country, where the land is only gently and to no very great height, perhaps as much as 100 or 500 or it may be as much as a thousand, feet. Then there are *mountains*, where the land rises to much greater heights and the sides of which are very

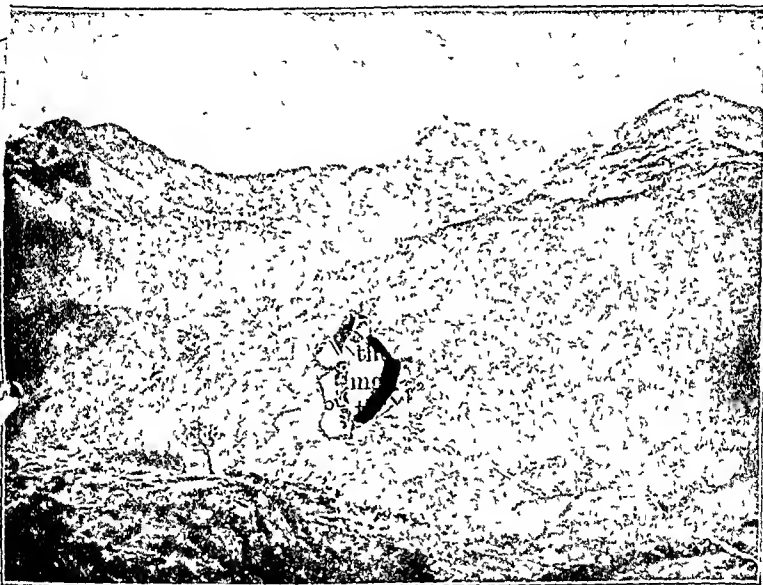


[Courtesy South African Railways]

FIG 19—Photograph taken from an aeroplane. A country consisting of a large number of small hills

much steeper. We do not usually talk about a mountain unless it rises to at least a thousand feet above the level of the sea. But we cannot very easily have hills or mountains rising high above the general level unless we have the individual hills or mountains separated by hollows. These hollows are the valleys, and usually the valleys are occupied by rivers. Sometimes a valley is broad and open, some valleys, if you tried to draw a section of them,

and the U-shaped, in others the river has cut a deep
 eren and so they are V-shaped. Then there are many
) which are deep and narrow and may be very rocky
 form gorges. In some valleys the sides are very, very
 steep indeed, and the river lies right at the bottom of a
 very deep hollow, which in that case we call a canyon



[Photo Abrahams

FIG. 20 — A view of mountainous country, with the tops of the mountains snow covered

Then again we may have areas of the earth's surface which are flat, or almost flat, like the surface of a table above the surrounding level. We call such elevated tracts plateaus.

Before we go any further let us be quite sure we understand some of the simple geographical terms which are

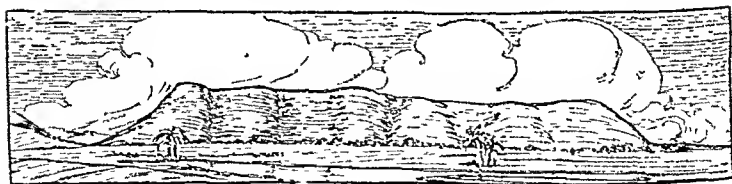
in common use. Of course we all know what an island is, a piece of land cut off from the larger masses and surrounded by the sea, or by water. Sometimes such



[Photo U. S. Government]

FIG 21 —A river flowing through a deep canyon.

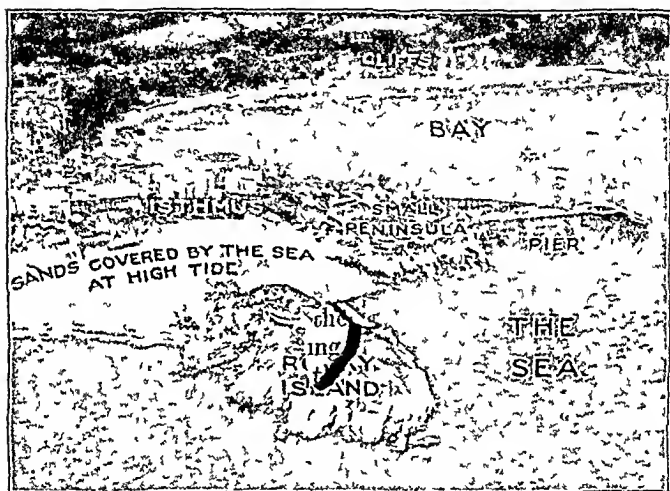
of land is not quite surrounded by water, it then forms a peninsula, and the narrow neck of land joining it to the



✓ FIG 22 —Diagram of a plateau

larger mass is called an isthmus. Pictures and a little map will help you to understand some more of these terms. A piece of land which juts out into the sea is called a cape

d to land, whilst when the sea occupies a hollow in the
 eren is said to occupy a bay or a gulf. Then, of course,
 1) C at land masses of the world are called continents,
 ne — the greatest masses of salt water form the oceans.
 A smaller area of salt water forms a sea. There are a few
 terms also which you must remember in connection with
 rivers. Where a river commences there is very often a



[Photo Aerofilms, Ltd]

FIG 23 —A photograph taken from an aeroplane.

little spring of water bubbling up out of the ground, called its source. Where it enters the sea is its mouth. In its course from its source to its mouth, a river is joined by smaller streams, which are called its tributaries, and very often before it reaches its mouth or the sea the river breaks up and actually reaches the ocean through a number of different channels. that is to say, the river breaks up into distributaries instead of reaching the ocean as one large stream. A river and its tributaries drain the water

away from a large tract of land, and the whole of the



FIG. 21 — A map showing an island, a peninsula, etc.

which it drains in this way is called the basin of the river



FIG. 25 — A river basin

Sometimes the river broadens out and occupies a hollow

surrounded by land, and this tract of water then
 lake. Most lakes have a river draining into them,
 to an exit with a larger river draining away. But
 are lakes or inland seas which have no outlet in this

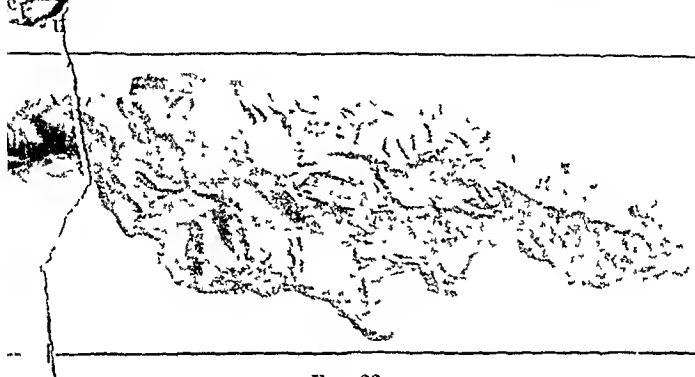


FIG 26

In the last section we have seen something about maps. But a map is a flat piece of paper, and we must have some way of showing on it hills, mountains, and valleys. There are several ways of doing this. One is to make a model of the country and then to photograph the model. But this only gives a very general idea of the country, as you see in Fig. 26. Another way is to use what are called "hachures." Hachures are plain or broken lines running down the slope of the hills, thick and close together where the slopes are steep. Fig 27 shows you a mountainous island with two peaks. This is not a very good method, for various reasons; one is that the hachures often hide the names printed on the map.



FIG 27—Hachures

The best method of showing physical features is by contours. A contour is an imaginary line passing through all points at the same height above sea level. If you could walk along a contour line you would thus go neither uphill nor down—you would go round all hills at the same height. Or think another way: if the sea rose everywhere 100 feet above its present level, places less than 100 feet above the present level of the land would be covered with water. We should have a new coastline, and this coastline would be the same as the present 100-foot contour. Similarly, we can imagine

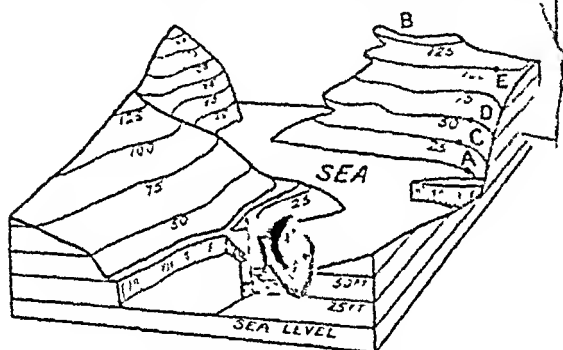


FIG. 28.—Diagram showing the meaning of contours

sea rising 200, 300, 400 or 500 feet, and giving us new coastlines one after the other, following along what are now the contours. Contoured maps can be made even clearer by colouring the land differently according to its height. Usually lowlands—for example, lands up to the 500 feet contour—are coloured green, lands above that yellow or brown.

Fig. 29 represents an island with contours shown. Below it is a section. Notice very carefully how it is constructed.

We sometimes talk about the everlasting hills, but actually there is no part of the earth's surface that is

...ing, and in reality changes are going on all the
 erent. You ought now to know something about the
 1) *Changes* which are taking place on the surface of the earth
 Perhaps we can say at once that the changes are of three
 kinds :

—1) There are the slow changes which are taking place
 most continuously. Whenever a shower of rain falls
 washes away some of the soil, and that soil is carried

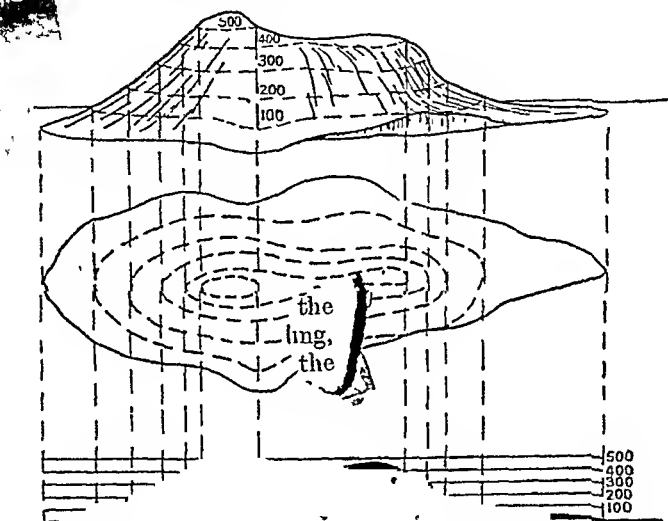


FIG. 29.—A contoured drawing, map and section

by streams and rivers to another part of the earth's surface
 and very often is there deposited.

(2) Then we read in our newspapers of earthquakes and
 sometimes of volcanoes erupting. These are sudden
 changes which take place on the earth's surface

(3) Then there are slow changes of another character.
 Some parts of the earth's surface are rising gradually,
 other parts are sinking gradually. Let us take each of
 these groups of changes in turn.

The slow changes due to the gradual wearing away of the surface —

As soon or even before dry land is formed above the surface of the waters of the ocean there are many dis-

agents which are waiting to attack that land and to wear it away:

(1) *Rain*. — We have nearly all of us seen what can happen after a heavy shower of rain. The water, pouring down as big drops on to the earth's surface, will wash away some of the loose particles of soil, and we know how even the gutter at the side of the road can be full of mud after a rain-storm. In very dry countries where rain does not fall very often a single rain-storm may often do a great deal of damage, and may descend on soft sand or



(Photo L. D. Stamp)

FIG. 30 — An earth pillar in the dry belt of Burma

The rain has washed away the soft sand and pebbles except where they are protected by a mass of hard sandstone

soft sandstone which can very easily be almost completely washed away except when protected by hard stone or a hard mass of rock. Look at the picture, which was taken in a dry country, and you will see how a mass

and to the rock can protect the soft sand underneath and prevent these sands from being washed away by rain, but 1) Could the hard rock the soft sand has been removed, so we get standing what is called an earth pillar. This shows very clearly what a large amount of sand must



[Photo L D Stamp

FIG 31 —A cave or cavern

have been removed by rainstorms. Then the rain, passing through the atmosphere, has dissolved certain gases, particularly one about which we shall learn presently, called carbon dioxide. Rainwater which has carbon dioxide in solution is capable of actually dissolving certain different kinds of rock, notably that called limestone. In limestone

districts the rain sinking into cavities in the soil displace some of the rock. And this is the way in which the large caverns have been formed underground.



[Photo L. D. Stamp]

FIG. 32 —A river in the upper part of its course, when it is running very swiftly.

(2) *Running Water* —During and after a rainstorm the little raindrops when they reach the surface of the earth join together; and so you see that a tiny stream can be formed which may be running down the side of a road or

and to a field. The little stream is muddy because it is filled with it some of the mud which has been removed from the roadside, and the mass of water itself moves more—it may be mud sand, and perhaps even small stones. Then the little streams join together and form a river, and we may see a big river full of muddy water sweeping along and gradually eating away its own banks. Thus a river really works in three different ways. First, as an agent of denudation a long word which means the “laying bare” that is to say, it washes away the soil and lays bare other parts. Then the river sweeps along the mud with it, that is to say, it acts as a carrier or a transporter: we call that the transporting work of the river; and then near the mouth, where the speed of the current is much less, the river is no longer able to carry its burden of mud and sand and so deposits it there, and reaches the sea through this area of deposited land called a delta. Here its work is deposition.

(3) *Frost and Ice.*—The work of frost and ice is very important in cold countries and in countries which have a cold winter, as our country has. Have you ever noticed the what happens to a jam-jar which has been full of water and has been left outdoors on a cold frosty day? The water inside has been turned to ice, and when water changes to ice it expands and grows larger, and the result has been that the glass jar has been split. Sometimes we have frosts so severe in this country that the water in our water pipes freezes and the water there expands and bursts the pipes. When the thaw comes again and the ice changes into water we find that our pipes have burst and are leaking. Now try to imagine what happens on mountain and hillsides. The rainwater gets into small cracks in the rocks, then the frost comes and the rainwater freezes. When it freezes it expands and so the crack is widened. Later other frosts will widen the cracks still

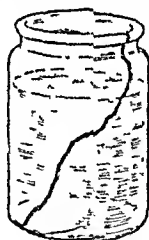


FIG 33

more till last of all a big angular fragment of rock is broken off from the main mass and such pieces tumble down from the mountain or the hill into the bounding valley. That is why nearly all mountains it is very cold consist of jagged, angular rocks. They are jagged because of these sharp pieces which have been



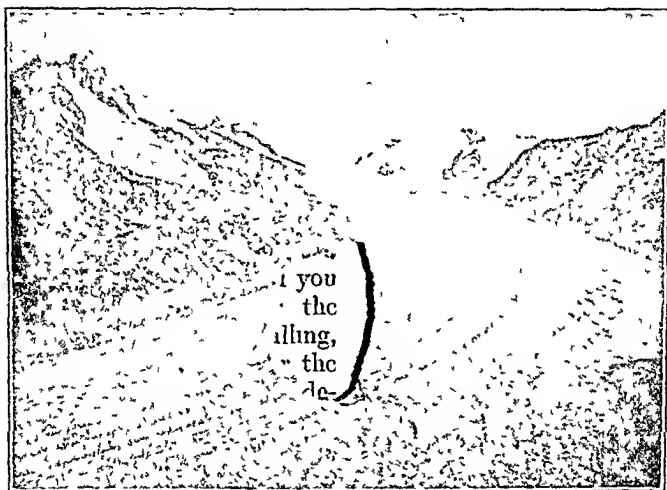
(Photo Canadian National Railways.)

FIG. 34 — A scree of sharp stones, broken off by frost action.

broken off by frost action. Then at the base of such mountains in the valleys we see enormous piles of stones all of which are sharp edged, and these piles we call scree. (The scree has been formed by frost action.) Of course some of the blocks of stones broken off by frost action may fall into the valleys and be carried down towards the sea by the rivers, and in that case the stones

and to become rounded by being rubbed against one another and the sharp edges are worn off.

1) In some countries or in very high mountains it is cold all the year round for there to be no rivers. Instead of rivers we have frozen masses of ice which we call glaciers. Glaciers then are really frozen rivers. Just as a river flows down a valley so the glacier flows down a valley. It is gradually fed from behind by masses of snow and moves, it may be very slowly, down the valley. But you



[Photo Exclusive News Agency]

FIG. 35 —A glacier

can imagine that a great heavy mass of ice flowing even slowly down a valley must have a great effect. It smoothes the hard rocks over which it passes, and very often scoops out hollows in the floor of the valley.

Instead of having a valley like that of a river, with the river flowing at the bottom of a V-shaped section, a valley which has been occupied by a glacier is U-shaped. Ice cannot flow from side to side like the waters of a river, and so we find these glaciated valleys are long and straight instead

of winding from side to side and having spurs like a valley. Look at the pictures very carefully to see. A glacier is often helped in its work of wearing a valley by the great stones which are broken off from the sides of a valley (often by frost action) and which go down deep cracks in the ice, or, to use the proper name for these deep cracks, into crevasses. There they reach the bottom and become frozen into the base of the glacier so that the ice, as well as smoothing the rocks over which it passes, is armed with great hard masses of stone, which do still more damage by scraping away the floor of the valley. Stones which are broken off and are carried down by the glacier in this way whether frozen into the bottom

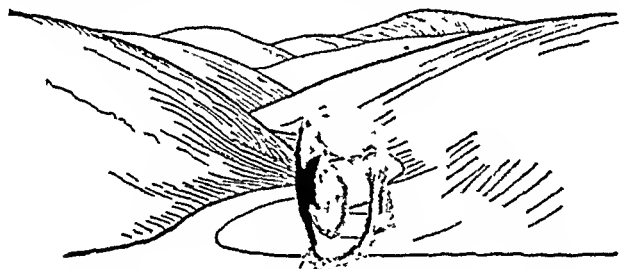
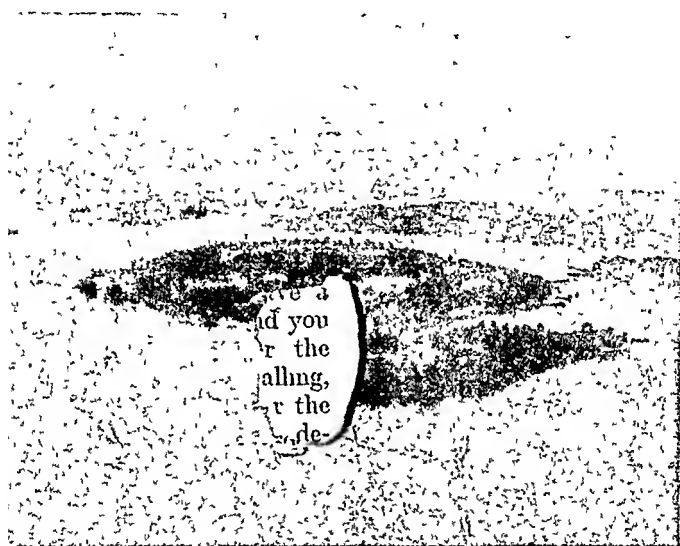


FIG. 36 —Diagram of a river valley with interlocking spurs

or just lying on the surface, we call moraines. When a glacier reaches lower levels or reaches warmer tracts of air the ice, of course, melts, and so we usually find issuing from the end of a glacier a river. This river will carry with it some of the sand, mud and stones brought down by the glacier, and so we often get spread out in front of the glacier where it is melting a great mound of glacial deposits, as we call them.

Then, besides the glaciers which occupy valleys, some of the very cold countries are covered by an enormous sheet of ice. Look at the map and find the country of Greenland. Practically the whole of Greenland is covered by an enormous mass of ice, in some places more than

ed to let in thickness. The same is true of one of those
 erent its of which we spoke some time ago, the continent
 1) Co-retica, which is situated all round the South Pole.
 most entirely covered by a great sheet of ice. Long,
 ago many parts of the earth's surface were very much
 older than they are to-day and our own country, the
 ritish Isles, was at that time covered with several sheets



[Photo L D Stamp

ig 37 —View taken from an aeroplane of a country built up of hard
 rocks, which has been smoothed by a great ice sheet. The hollows
 are now occupied by the sea, and the hummocks form islands

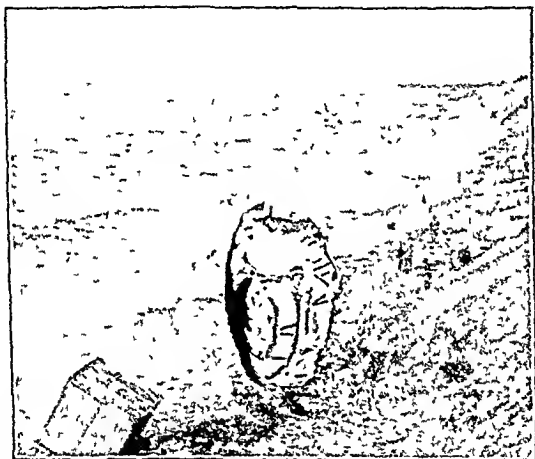
f ice. We call this period the Great Ice Age, and we still
 ave scattered over many parts of England great bloeks
 f stone brought by these glaciers, and many mounds of
 nd and of elay (often full of great stones) which were
 id down when the ice melted. All these we call glacial
 eposits. And if you live in the north of England you
 ay have seen great stones seattered about which have

and to in China are almost completely covered with this
 different Look at the picture of the sphinx which is given
 1) Contrast page It is a monument made many thousands
 years ago by men in the dry desert regions of Egypt,
 and since it was carved out of the hard rock many storms
 of wind blowing particles of sand from the desert have
 gradually worn the sphinx away. You can see this quite
 clearly if you study the picture

(5) *The Sun*—Then there is the work of the sun in
 wearing away the surface of the earth. This at first seems
 strange—but the work of the sun or, as we call it, insolation,
 is important in very hot countries, especially in hot, dry
 countries. During the day the sun shines down on masses
 of rock and makes them very hot indeed, so hot that you
 could not possibly stand on them. Then at night time,
 after the sun has set, the earth gets quite cold and the
 rocks get cold too. Now when many things are heated
 they expand, but they do not expand or grow larger at
 the same rate, and so if you have minerals, or substances
 of which a rock is composed, they do not always expand at the
 same rate when they are heated by the sun during the
 day. Some grow larger more quickly than others, and in
 so doing they split the rock and so we often find in hot
 tropical countries that layers or sheets of rock are actually
 split off by the action of the sun

(6) *The Sea*—Last, but not least, we have the action of
 the sea. Most of you, no doubt, have been to the sea-
 side and you know that sometimes in rough weather there
 are great waves. These waves beat against the shore,
 and even where a strong promenade has been built by man
 the waves are often able to do a great deal of damage.
 Not only is there great force from the water, but the
 waves pick up masses of stone and shingle and in rough
 weather throw these against the cliffs or the shore and
 so wear them away. When we pass to the British Isles we
 find high cliffs, such as the chalk cliffs of south-eastern
 England, which have been worn by the sea in this manner.
 There is no doubt that once the British Isles were joined

to the Continent of Europe and that the chalk stretched right across from south-eastern England to Dover—to the north of France; and gradually the sea worked hard and has cut a passage between the two that we now have the Straits of Dover separating England from France. Not only can the work of the sea make high cliffs in this way but the masses of stone which are broken off by the action of the water are beaten against



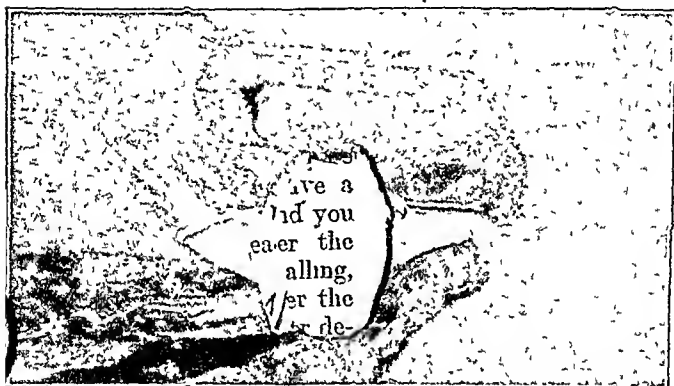
[Photo Topical Press Agency]

FIG. 39.—A picture showing how the sea has eaten away the cliffs during a storm and destroyed some beach huts

one another and are turned into those round pebbles which we can see on almost any sea beach. Pebbles are often ground so finely that they form the fine sea sand which occurs on many of our coasts. The shingle and the sand are washed along the sea shores from one place to another, so that we often find pebbles which must have travelled a very long way. But the action of the sea does not extend down to any great depth. Even in the fiercest storms it is possible to dive down where the sea is very

and to find the water quite still. So where wave action is most round the coasts the sea cuts out what we call a 1) Continental Shelf. The result is that round many countries in the world there is an area of shallow sea, a sort of shelf, the Continental Shelf. We shall learn about the Continental Shelf surrounding the British Isles at a later stage.

In the deep, tranquil or quiet parts of the sea many small animals live, and when they die their remains fall to the bottom and form there a deposit. Mixed up with



(Photo Air Views, Ltd)

FIG 40 —Cliffs and a deep bay or cove worn by the sea

these remains of animals we find particles of mud: and so, forming at the bottom of the deep ocean very slowly, we get deposits of such things as mud and the shells of small animals

We have now learnt about the principal slow changes that are taking place over the surface of the earth. There is the work of wearing away, or denudation, the work of carrying material from one part to another, or transportation; and the work of placing that material such as the sand and gravel and mud or depositing it in a new place,

which we call *deposition*. We must now learn something about the quick changes which take place on the surface caused by earthquakes but before we do let us learn a little about the inside of the earth, underneath the ground.

SECTION IV

UNDER THE GROUND

WE have now learnt something about the surface of the earth and we must try and see what lies underneath; for really the appearance of the surface, whether it is a plain or whether it is mountainous, depends on what is underneath. The solid part of the earth on which we stand is called the earth's crust. We find that if we dig a deep mine it gets very hot as we go downwards from the surface, and at a depth of about a mile or perhaps two miles, it would be so hot that it would be difficult for men to work. So we believe that lower down there must be a layer in the earth's crust that is so very hot that almost all the rocks would be melted, and it is from these lower layers in the earth's crust that the molten rock comes up which is poured out as lava from volcanoes. A long time ago men used to think that the interior of the earth must therefore be a liquid mass, but we know that is not the case, and very probably the centre of the earth consists of a great solid ball almost entirely made up of iron.

How can we learn something about the interior of the earth's crust? It is often only in a few places that we can see of what it consists. Where we have cliffs round the sea coast, and where man has made pits or quarries we can see what underlies the surface. A new railway

and to may show us something, and even sometimes when a different house is being built and it is necessary to cut out 1) Co foundations, or when a new sewer is being made in e ad we can find out something about what lies under- each We know that sometimes the materials that are dug up in this way are soft, such as clay or sand or gravel, in other places they are harder, such as chalk, whilst in still other places they are very hard rocks, such as the granites and the limestones that are often used in building Now the geologist, as the man is called who studies the structure of the earth, has one name for all these materials, whether they are hard or soft, he calls them all rocks So when in this book we talk about the rocks of the earth's crust you must remember that they may be of hard or soft materials.

The geologist has found that there are four great classes of rocks that make up the surface of the earth So let us look at each one of these

(1) Sedimentary and you called stratified rocks
We have learnt already the why in which rivers work

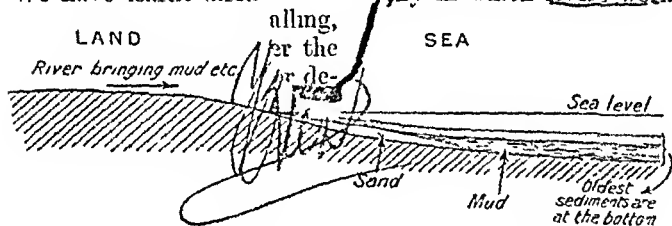


FIG. 41.—Diagram to illustrate the formation of sedimentary rocks

by wearing away a part of the land, carrying down sand or mud, and then depositing that sand or mud when the river reaches the quieter waters of the sea or flows into a lake And so we get layers of "sediment" which have been formed in this way. (The layers will naturally be spread over a wide area of the floor of the sea or lake, and we call such layers strata. This is a Latin word, so that the singular is "stratum") You will see at once that

the stratum at the bottom is the oldest, since deposited first on the floor of the sea or of the land. You can see, too, that if there are any fish or other creatures living on the floor of the sea and they die, they sink to the bottom and may get covered up by the sand and mud brought down by the river. You can think then of the floor of the sea being covered by layers or strata of these different *sediments*. Now imagine an earthquake or a series of earthquakes. Earthquakes often cause some parts of the land or sea to rise up, other parts to sink down, and so the whole series of sediments which have been laid down on the floor of the sea may be raised up to form dry land. Even at the present day when we have

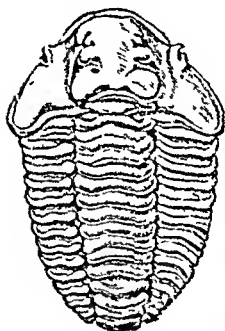


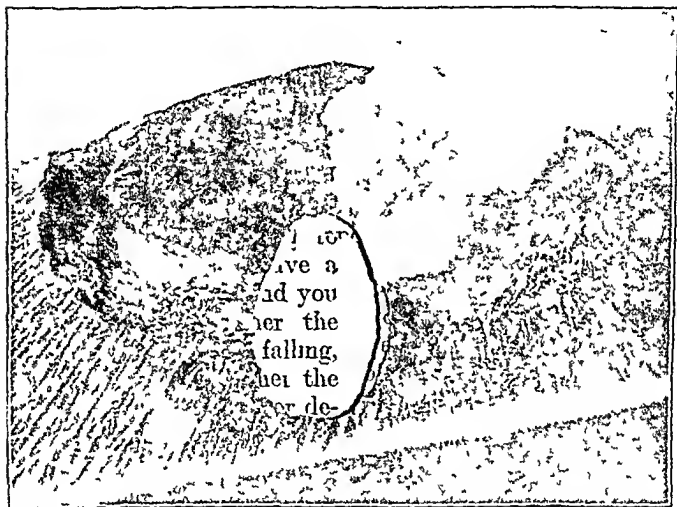
FIG 42 — A fossil

severe earthquakes this sometimes does happen. When sediments which have been laid down on the floor of the ocean or of the land are gradually lifted to form dry land we shall be able to say that the land is composed of *sedimentary* rocks. We can prove that the land has once been under the sea, because we shall find the remains of fishes or other creatures, or at any rate their hard parts—their bones—have been preserved in the midst of the clay or the sand. These remains of creatures

that once existed are called *fossils*. We get fossil shells, fossil fish, and fossil plants in some of our rocks. But when an earthquake or a series of earthquakes causes the floor of the sea to rise with its sediments in this way, as a rule it does not rise evenly. One part rises more than another, and so we get the strata of the sediments crumpled or folded. You will learn something about these folds presently.

(2) **Igneous Rocks.**—The word “*igneous*” comes from a Greek word *igne*, meaning fire, and so igneous rocks are

led to the fiery rocks, or those rocks which have been in
 erent lower layers of the earth's crust. I think all
 1) Co must have seen pictures of a volcano. A volcano
 is to be called a burning mountain, but this is not at
 all correct. A volcano really marks a hole or crack in
 the earth's surface through which some of the molten
 rocks from deep down can come up and spread over the



[Photo Aerofilms, Ltd

FIG. 43.—Photograph taken from an aeroplane of an active volcano showing clouds of steam coming from the centre of the crater

surface. Sometimes the lava or molten rock comes up
 gradually, almost like a stream of water, at other times it
 comes up with great bursts of steam and smoke, and large
 blocks of rock or fine pieces, called ashes, are thrown out.
 And so we may get a volcano building up round itself a
 cone of ashes and lava. We see one in the picture. But
 in other places the molten rock may just spread evenly
 over the surface of the ground. In this case we get

considerable areas of the earth's surface covered particular type of igneous rock which we call rock

But in many parts of the world although there be these molten rocks underneath there are no cracks through which they can reach the surface. The molten rock forces its way up as far as it can and sometimes almost reaches the surface, and may for that reason cause earthquakes. But before it actually reaches the surface the molten rock ceases to move and gradually becomes cool and solidifies and so we may get igneous rocks which have been formed in this way without reaching the earth's surface. You may say, how do we know they are there?

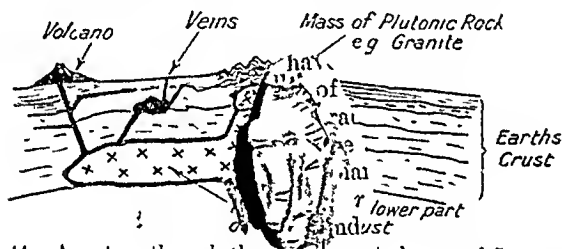


FIG. 44 —A section through the earth's crust showing different types of igneous rocks

Do not forget the agents of denudation—the rain, the rivers and the frost and so on—that are continually wearing away the earth's surface. They often wear away so much that they will bring to view these igneous rocks which have solidified slowly underground. You have nearly all seen granite. Granite is a very good example of a rock that has been formed in this way. When you have a opportunity look close at a piece and you will see that it consists of quite large crystals. These crystals have been able to form because that rock, once molten, was able to cool slowly underground. Try and see how many different kinds of crystal you can see in a piece of granite. Igneous rocks, both volcanic rocks and these, which have

and to deep down in the earth's crust and which we
 different igneous rocks are important to the geographer. Very
 1) Volcanic rocks after a little while weather quickly
 in a very good soil, and many of the richest agri-
 cultural regions of the world are on old volcanoes. That
 is one reason why people although it may be dangerous,
 often go and live in volcanic regions. The plutonic rocks
 are important to man in many ways. The granites form
 very good building stone, but are also very important
 because when this molten material comes up from below
 it brings with it the ores of many of the metals. The ores
 of gold and silver, of copper, tin, lead, zinc and many
 others have come up as a rule from the interior of the earth
 in this way, and so we often find in regions where plutonic
 or volcanic rocks are common there are important mining
 areas.

(3) Metamorphic Rocks. This is another long word
 derived from Greek meta we have a very meta, which means a
 change, and morphe—and you therefore means rocks which
 have changed their form. You will see that when hard
 rock is melted at our falling, very hot indeed, and as it
 comes up from the lower the of the earth's crust it must
 do a great deal of damage to the other rocks through
 which it passes. It heats them and changes them into
 something quite different from their original form. You
 know what happens when clay is taken and moulded to
 form bricks. It is put into the kiln, it is burnt into a
 brick, and is then something quite different from the clay
 from which it is formed. So if you have hot volcanic
 rocks passing over a bed of clay, they turn that clay into
 something hard and quite different. Similarly, too, when
 earthquakes cause great pressure and great folding in the
 earth's crust the rocks may be changed by the high pressure
 into something quite different. And so we have this long
 word "metamorphic" for those rocks that have been
 changed in this way. These metamorphic rocks are often
 very hard, and so you will find they resist the action of
rain and rivers, and so stand up as mountain chains on the

earth's surface or as high land. A very good example is a metamorphic rock which you have all seen is Slate. Slate was once just ordinary soft clay, but by great pressure it has been converted into hard rock which splits easily in a certain way, and that is why it is very useful for roofing our houses.

(4) **Organic Rocks.**—This word means that the rocks have been formed from organisms, or animals and plants. Suppose you think for a moment of the quiet parts of the great seas or oceans. There are no rivers flowing into them, and so there is no mud, sand or other sediment. There are living in the surface waters of the ocean, far too small for us to see, millions and millions of tiny creatures which build up a hard shell of material very like chalk. When these tiny creatures die they fall to the bottom of the ocean, and gradually, but very slowly, the hard parts give rise to a rock which is formed entirely of the remains of these tiny animals. The first men that have sounded (that is, have found the depths of) the great oceans and have brought up samples from the bottom, find these forming at the present day, and have called them oozes; and you can see that if the floor of the ocean were covered with these oozes, is raised up to form a land, we shall get a rock of a rather peculiar character. A rock actually formed in this way is the familiar white chalk so common in the south of England.

Then we have rocks which are formed from the remains of plants. You have all heard of, if you have not seen, peat, and you know that in boggy places moss and other plants will grow and then die, and other plants will grow on top, and gradually a thick layer is formed which the poor people in country districts—for example, of Scotland, and Ireland—dig out and burn instead of coal. If then, is an organic rock formed of the remains of plants. But still more familiar is a rock formed of the remains of forests which existed millions and millions of years ago: that rock is the coal which all of us know. The forests grew and then were covered by masses of sand and

and brought down by rivers after an earthquake, and so different seams were formed from which we get the coal at the present day. Two good examples, then, of organic are certain limestones formed from the remains of animals, and coal formed from the remains of plants.

In the last chapter we learnt something of the slow changes which are taking place as the result of rain, rivers, frost and ice. But there are also those changes of the earth's surface which take place in a different way, namely,

The sediments when laid down are like this



Earthquakes fold them like this, and the tops of the folds are worn away.

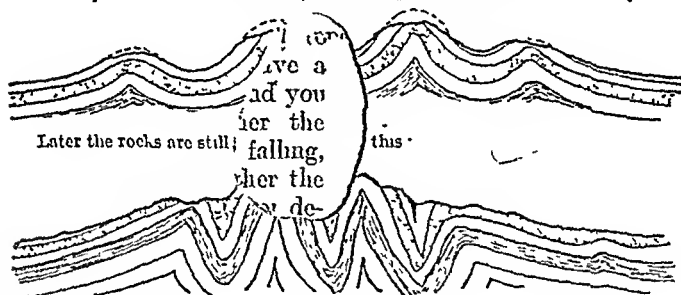
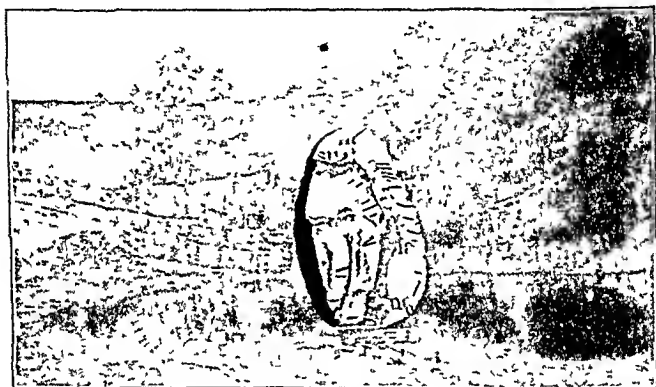


FIG 45.

earthquakes. Many, if not most, earthquakes are due to the movements deep down in the crust of the great masses of molten rock. Sometimes the earthquakes raise big tracts of the earth's surface gradually upwards, others lower them so that the sea covers those areas that were once land. In the great earthquake which destroyed the chief port and much of the capital of Japan in 1923, the sea floor around Japan rose as much as 1,500 feet as the result of the one earthquake. But when an earthquake or a series of earthquakes causes a mass of sediment to be

raised up above the level of the sea it nearly always the strata of those rocks, sometimes into gentle folds, sometimes into sharper folds. The simplest form is an arch, or an anticline, and the opposite is a hollow, or a syncline. We may get anticlines and synclines tightly packed together as you see in the diagram, but the important point to remember is that as soon as these folds are formed the agents of denudation the rain and the rivers, get to work and so we do not find that the surface of a single bed or stratum runs along the surface of the ground for



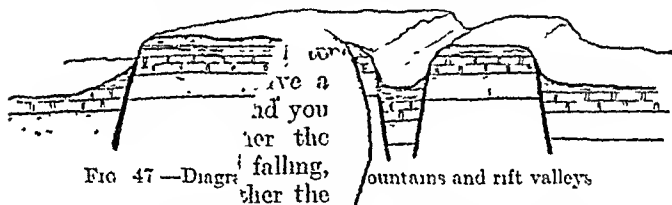
[Photo L D Stamp.]

FIG 46 —Folded rocks (a syncline) in an old quarry.

any distance. When we talk then about the slope or the dip in the strata of the earth's crust, we do not mean the same thing as the slope of the land. It is something quite different.

When a part of the earth's surface has been highly folded we usually get formed as a result chains of mountains. Nearly all the great mountains of the world are, as we say, folded chains, because they have been formed by the folding of layers of the earth's crust. But there is another change which is caused by earthquakes. Some of

Under rocks naturally do not fold easily, but instead break or crack. We call these breaks or cracks in the earth's surface "faults." We cannot usually see them. 1) *Concordance*, because the two sides are easily forced together, but that the rocks on one side of the crack move upward and on the other side of the crack move downwards. Sometimes a big mass of the earth's crust is forced up between two cracks and we get a mountain which we call a block mountain. At other times a big mass of land slips down between two cracks and we then get formed what is called a rift valley. The little diagram will help you to understand what is meant by block mountains and rift valleys. Notice that what we have already said enables us to classify mountains into four groups: fold mountains, formed by folding in the earth's crust, block



mountains, between *folded* mountains of accumulation, such as volcanoes (when the material is thrown out of the earth's crust), and mountains of denudation (where the surrounding land has been worn away).

You may say we do not very often get earthquakes now, and we do not see great chains of mountains being formed. That is because the present period in the earth's history is a comparatively quiet one. But there have been other periods in the earth's history when exactly the opposite has been the case. These are the great mountain-building periods. Nearly all the great mountain chains which we can trace on a globe or on a map of the world at the present day were built up at one and the same period. Even then there were only some parts of the earth's surface which were affected by the mountain-building movements. That

THE REGIONS OF THE WORLD

is why we usually find the great mountain chains, whereas there are other parts of the earth's surface are scarcely folded at all. It is just the same with volcanoes. There seem to be lines of weakness run through the earth's crust, and along these we find volcanoes. Look at the map of the world and notice how the volcanoes seem to follow certain quite definite lines.

Before we leave this section we ought to learn something about the useful substances which man gets from the earth's crust. In the first place there is water. When

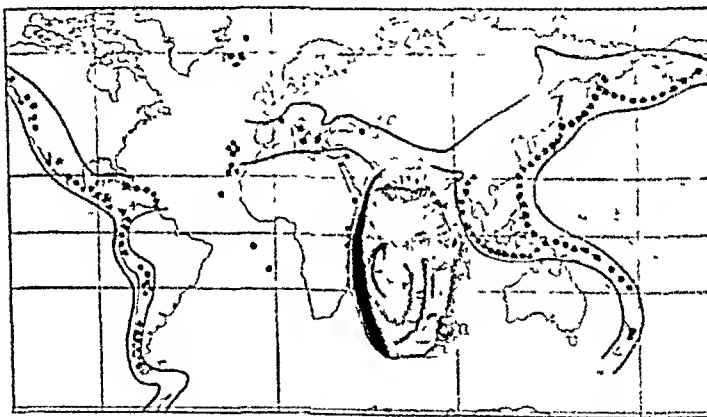


FIG. 18.—Map of the world to show lines of volcanoes

rain falls on the surface of the ground some of it collects together and runs away as a stream, but some of it soaks into the ground. Now there are some rocks through which rainwater can pass (porous or pervious rocks), and there are other rocks through which it cannot pass (impervious rocks). You can imagine that it can very easily soak through a bed of sand, but if it gets to a bed of clay it will not soak through but will run along underground. It may run along under the ground until the bed of clay itself comes to the surface, and then we find that the rain-

comes out again at the surface and forms what we call a spring. Look at the diagram carefully and you will see how certain types of spring are formed. In some parts of the world the rocks underlying the earth's surface are in the form of a basin, that is, are shaped rather like a saucer. If the underlying rock is of clay or of other rock through which the water will not pass you can

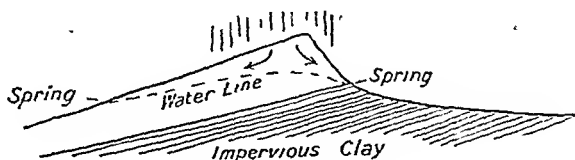


FIG 49 —A spring

see that rainwater will draw from the edges of the basin towards the centre of the basin, and a great quantity of water will there collect. If a well is bored, as you see in the diagram, towards the centre of this basin the water will very often gush out of the well. We call such wells artesian wells. In some parts of the earth's surface where artesian wells are very useful.

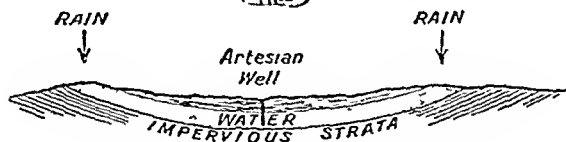


FIG 50 —Section showing an artesian basin

Then there is the very important mineral coal. We have already learnt how coal has been formed from the remains of forests and is found between layers of sedimentary rock. So coal occurs in seams which are just like the strata of the sedimentary rocks. The seams of coal may be folded into anticlines and synclines and broken by faults, and that may make the mining difficult. Coal is

THE REGIONS OF THE WORLD

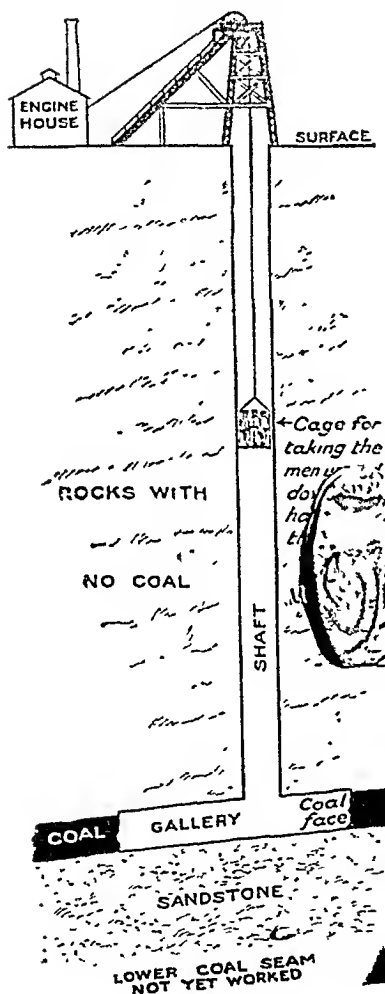


FIG. 51 —A coal mine.

usually mine digging a hole in the shaft in the and working of coal seams from the bottom of the shaft. You will see that coal always occurs amongst sedimentary rocks, never amongst metamorphic or igneous rocks, where it would have been destroyed by the heat.

Another mineral is oil. This is a liquid, but it does not occur in the same way as water, because oil is lighter than water, and as there is usually water also in regions where oil occurs the oil always floats to the surface of the water, and so instead of being found in hollows or synclines of the rocks it is found underneath the arches. The little diagram shows this. A hole has to be bored or a well drilled and the oil may flow out of it, or can be got out by pumping.

and to there are all the metallic ores and the precious
 erent Most of these have come up in molten condition
 1) Cracks from the interior of the earth, and so are found
 ons of igneous or metamorphic rocks usually occupy-
 narrow cracks or, as they are called, veins Sometimes

the agents of denudation have washed the valuable metallic ores out of their veins, and we may find such things as gold or tin ore as stream deposits or even amongst sedimentary rocks. In such cases they are called alluvial deposits, because the fine mud which is deposited by rivers at the present day at their deltas, on either side of their banks when they overflow, is called alluvium. There are some ores, particularly iron ore, which may be found either in sedimentary

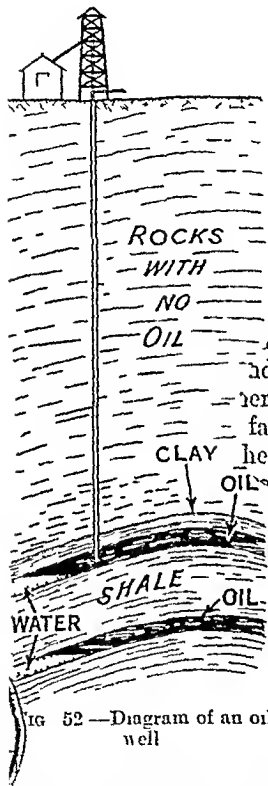


FIG. 52.—Diagram of an oil well

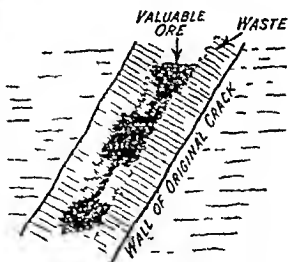


FIG. 53.—A vein.

rocks in thick beds, almost like coal seams, or may be found as masses amongst igneous rocks. Iron ores are thus found in many parts of the earth's surface. But notice that it would be very silly to look for coal or oil in regions where the rocks are mainly volcanic, and it would

not be of very much use to look for many of the minerals in regions where there are young soft sedimentary rocks

SECTION V

WATCHING THE WEATHER

How often we talk to one another about the weather. Often we say, "Isn't it hot to-day?" or "Isn't it cold to-day?" Sometimes we say, "Oh, bother, it's raining," or perhaps, "How windy it is to-day!" Sometimes we talk about the air being "heavy" or "oppressive." You see that in talking to one another we pick out a feature of the weather which happens to strike us most. In order to study the weather completely we have to study a number of different things. The things we are

- (a) Heat and cold, or temperature.
- (b) The moisture in the air, or humidity.
- (c) The pressure of the air.
- (d) The movement, or wind, which results from differences in pressure.
- (e) Rainfall.

Let us now look at each of these things in turn, but before we do that we must learn something about the air itself. Although we cannot see it, we know that we are surrounded by air, and we can feel this air when it moves as wind and blows against our faces. If there were no air we should not be able to breathe or live. We can prove this by putting a small animal under a glass jar. An instrument called an air pump, which has to be used, has a well drilled hole in it. If the air is pumped out the animal dies. Air may flow although we cannot see it, consists of a gas or can be pumped and amongst other things the air has one-fifth of the air or atmosphere consists of oxygen.

and to its oxygen. This is the most important part of the atmosphere because it is the part which we breathe and which we need in order to live. If there were no oxygen in the atmosphere we should not be able to live, but oxygen by itself is rather strong and would be dangerous for us, so the other four-fifths of the atmosphere consist very largely of a gas called nitrogen. Nitrogen is like the water we mix with strong lemon squash or lime juice, and is mixed with oxygen to make the oxygen less strong. There are small quantities of various other gases in the atmosphere, but we need not worry about these except two of them. There is one called carbonic acid gas or carbon dioxide. When we breathe oxygen into our lungs, as you now, we breathe it out again. But when it is breathed out again part of it has been changed and has become carbon dioxide. Now carbon dioxide is really a poison to animals and human beings. If you have a small room where a large number of people are all breathing out this gas, after a short time the atmosphere becomes stuffy and the people begin to feel the effects. They get headaches, and if they are lying down they will eventually die for lack of oxygen and because they have been poisoned by the carbon dioxide. That is why we must always have fresh air in our rooms in order to keep healthy. But the carbon dioxide in the air has another use. It is taken in by plants and trees through little tiny mouths, or stomata, which they have in their leaves. It is used by the plant in building up leaves and roots, and the plants breathe out the oxygen from their stomata since they require only a little of it. That is why it is a good thing to have a few plants in a living-room during the day, for they help to purify the air. But at night the plants cease to give off oxygen and instead they take it in. But because of the work they do in the day they are found as mass^s healthy to live in a place where there is thus found in nature. You all know what happens if you notice that it is important gas in the atmosphere is water vapor. You all know what happens if you

put a saucer of water out in the sun, or what happens when you see a puddle of water in the road when the sun comes out. Quite quickly it disappears. Where has it gone? It has gone into the air. The water has been changed into water vapour, which we cannot see and which has passed into the air. It is important to remember, however, that the air can only hold a certain proportion of water vapour. After a time it gets as much water vapour as it can possibly hold, and we then say that the air is saturated with water vapour or moisture. Now let us look at the things we have to do in order to study the weather.

(a) *Heat or Temperature*—We measure the heat of the atmosphere by an instrument called a thermometer. There are different kinds of thermometers. The common one consists of a narrow glass tube with a bulb at the end and closed at the other end. The bulb and part of the stem are filled with a very heavy liquid called mercury. Now when it is heated the mercury expands and gets larger very much more quickly than the glass which it is surrounded by.

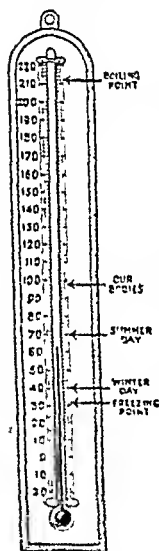


FIG. 51.—Thermometer

So if you breathe on the mercury in the bulb and make it warm the mercury expands and you see the little column shoot up in the stem quite rapidly. All we have to do then is to mark on the stem or on the piece of wood on which it is mounted a number of divisions which will tell us the amount of heat or cold. We find that the temperature of freezing water or rather of melting ice, is always the same, and we call this freezing-point. We find, too, that the temperature at sea level

of fresh water which is boiling, that is, of boiling water, is always the same. And so we have two fixed points on our thermometer. In our English thermometers we call

point 32 degrees (written 32° F), and boiling-point 212 degrees (212° F), so that there are 180 little degrees between these two points. On the Fahrenheit scale, as it is called, there are certain other useful figures to remember. There is the temperature of our body, which is just about 98° when we are healthy and which rises to over 100° when we are ill. We shall learn later much more about different temperatures, but it might be useful to remember that a warm room, about as warm as on a summer's day, is between 60° and 70° . Besides the simple thermometer which most of us have seen there is a special kind, or sometimes two separate

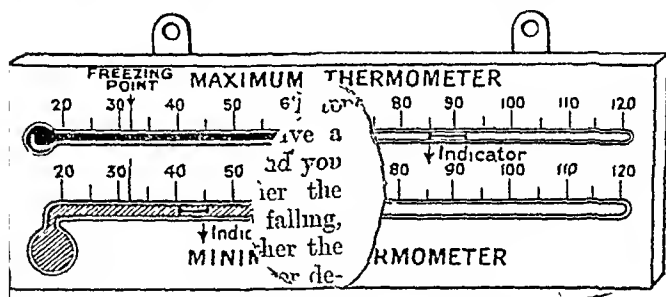


FIG. 55.—Maximum and minimum thermometers.

ones, called a maximum and a minimum thermometer. Inside the tube of the maximum thermometer there is a little piece of metal or glass which is pushed up and up as the temperature rises, but which stays at the highest point when the temperature drops. This thermometer therefore shows the highest temperature which has been reached during the day. In the minimum thermometer the little indicator is arranged to show the lowest temperature reached during the day. If the thermometers are therefore looked at once a day we can put down on a piece of paper or record in a book the highest and lowest temperatures reached during that particular day. We then shake the thermometers and put the little indicators so that the

thermometers are all ready to record for the month. The difference between the highest and lowest temperatures reached during the day is called the daily range. In some places, especially on high mountains or in a long way from the sea, the nights are very cold and the days are very hot. Such places are said to have a great daily range of temperature. If we take the average between the maximum and minimum temperatures we get the mean temperature for the day, then when the temperature has been recorded in our books for every day of the month we can find out the monthly average temperature. Some years are hotter than others, so it is much better if our observations are spread out over a number of years. The little table given here shows you how such an average is calculated.

Place	Year	Average January temperature
A	1921	46.2°
	1922	44.8°
	1923	45.1°
	1924	45.7°
	1925	46.8°
	1926	46.4°
	1927	44.8°
		7)319.8
		45.6° average

These average monthly temperatures are very important in geography. In most parts of the world the great difference is between the months of January and July. In the Southern Hemisphere the hottest month is usually January, and in the Northern Hemisphere it is usually July, and again in the Southern Hemisphere the coldest month, or the typical winter month, is usually July, whilst in the Northern Hemisphere it is January. If we take the temperature of the hottest month and the temperature of the coldest month the difference between them gives us

lead to a small range of temperature. Some places have only a small difference between winter and summer temperatures, perhaps only 5° or 6° , and these places are generally places that are near the oceans, for example, islands (Latin *insula* = an island). We shall learn the reason for this presently. Other places, especially those which are a long way away from the sea, such as in the interior of the great continents have a very great difference between their very cold winters and their hot summers. There are even places where the annual range is as much as 100° . Such places are said to have a continental climate. Notice that we have been talking all the time about the temperature of the air and this temperature is usually measured in the shade, that is, away from the sun, about five feet from the ground.

We must now learn how the air obtains its heat. The source of nearly all the heat we have is the sun. You can tell this at once on a summer's day if you quickly get very hot when you stand in the sun and cool when you go into the shade to get cool. As the sun's rays pass through the air they warm it very slightly, but the greater part of the heat goes towards warming the ground and the surface of the sea. The air near the ground or near the water becomes warm because it is closely in contact with them. It is because the air gets most of its heat from the surface of the ground in this way that it becomes steadily colder as we go upwards, although we are actually going nearer the sun. Thus it is very cold indeed on the tops of high mountains, so cold that there is nearly always snow there. You can really think of the air as a pile of blankets that are keeping the earth warm. A man living at sea-level has the whole thickness of the air above him to keep him warm, just as a man who is under a pile of blankets. But when that same man climbs a high mountain he has much less air above him to keep him warm, it is just as if he had climbed above most of his blankets and only had a few above him to keep him warm.

Where the blanket of air is thin the warmth is lost. Thus we find that for every 300 feet we climb up, the temperature drops on an average 1° . A place 3,000 feet above the level of the sea will have a temperature 10° lower than if it were on the plain. Suppose we were at the top of Cader Idris, one of the highest mountains in Wales, nearly 3,000 feet above sea-level, and we looked at a thermometer and found that the temperature was 41° . If that spot were at sea-level the tem-

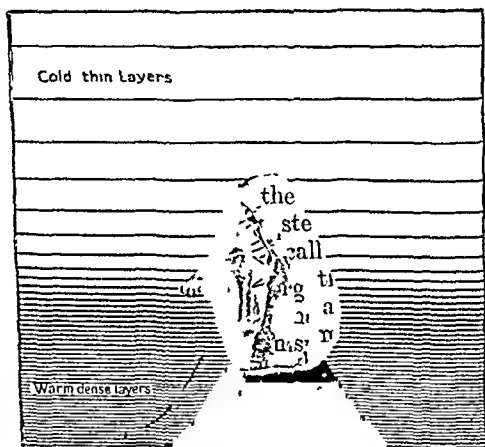


FIG 56 —Diagram showing why it is colder near the tops of mountains

perature would be $\frac{3000}{300} = 10^{\circ}$ higher, so that we find that the sea-level equivalent of the temperature at the top of Cader Idris is $41 + 10 = 51^{\circ}$. We call this reduction of the temperature to the sea-level equivalent.

There is a word that you ought to know and that word is isotherm. The part *iso* means equal, and if you hear a word commencing with *iso* you will know that it means something to do with equal. Isotherm means equal as regards heat, or equal temperatures, and an isotherm is

and to imaginary line drawn to pass through all places having the same temperature at the same time, and in drawing 1) *Comes* we usually reduce all the temperatures to sea

and remember if you have ever on a hot summer day sat down on a stone and then found that it was so hot that you had to jump up quickly. If on the same day you had put your hand into a pool of water you would have found that the water was fairly cool, that is, because the land—or earth or stones—gets hot quite quickly when the sun is shining, but during the night loses its heat quickly also. Water, on the other hand takes much longer to get hot but longer to get cold. We shall find that this is very important.

Why should we have a trouble to learn about the temperature of the atmosphere? I falling, one thing it is important for the farmer. He wants to know whether there is going to be frost, because if he plants his crops too soon

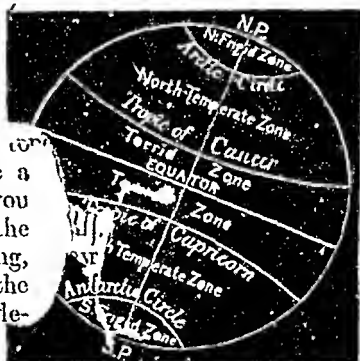


FIG. 57.—Diagram showing the heat zones of the world

the frost may destroy them. In studying temperature we know the crops it will be possible to grow in a country. It depends, too, on the temperature from day to day and from month to month what clothes we wear, whether we light a fire in our houses, and so on. We find when we come to look at the world as a whole that we can divide the earth's surface into a number of zones. The hottest part of the earth, that is, hottest all the year round, is near the equator. You have already learnt where the Tropics of Cancer and Capricorn are, and between them, across the equator is what we call the Torrid or Tropical

Zone, then on either side come the two Temperate Zones, the North Temperate Zone and the South Temperate Zone, then inside the Arctic Circle and the Antarctic Circle are the Frigid Zones, the North Frigid and the South Frigid.

(b) *The Moisture of the Atmosphere.*—We have already learnt that there is in the atmosphere a quantity of water which has become invisible and forms water vapour. It is not difficult to see how that water vapour got there. You know what happens after a storm of rain when the sun comes out. The puddles of rainwater on the ground or by the side of the road quickly dry up, as we say, because the water is turned into water vapour and passes into the atmosphere. We say, therefore, that the water vapour is obtained by evaporation of water on the earth's surface. Heat is the great cause of evaporation, and therefore evaporation is the greatest near the equator. Water vapour is only about one-seventh as heavy as air, and so it is rapidly spread by the wind. When it is very hot you know that you get very thirsty. You can go on drinking and drinking, but sooner or later you stop when you know that you have had enough. It is the same with the air. Hot air is very thirsty and it drinks up large quantities of water vapour, but there comes a time when the air cannot take up any more. The air is then said to be saturated. But cool air or cold air cannot take up nearly as much water as hot air, and so cold air is very quickly saturated. We measure the exact temperature of the air with a thermometer, and we must also have a means of measuring the dampness of the air. We do not use the word dampness. We talk about relative humidity. When the air is saturated, that is, it has all the water vapour it can hold, its relative humidity is said to be 100. When it is absolutely dry its relative humidity is said to be 0. When the air is half saturated, then its relative humidity is 50, and so on. We have to talk about *relative* humidity because if we change the temperature of the air, that at once makes a difference, for if we warm the air it can

and to take up more water vapour. You can see what will happen if you take very damp air, or 1) *Cool* air, and cool it slightly; it will not be able to hold so much water vapour, and some of the water vapour will be turned into liquid water. That is how we get the formation of clouds and rain. Try this for yourself. Your breath is warm and contains quite a lot of water vapour. If you breathe out against a cold surface, such as a window pane or a plate, immediately some of the water vapour in your breath will be turned into water and you will see little drops forming on the glass or the plate. The clouds that we see in the sky are formed in very much the same way. The warm, moist air rises from the surface of the earth, because the water vapour is so light and as it rises it cools, because you know it is not nearly so warm in the upper part of the air. Little tiny drops of water are formed and appear to us as clouds, the little drops collect together into larger drops which may fall as rain. Sometimes they evaporate again before they reach the surface of the earth and so we may have clouds but no rain. When falling, the air is very cold tiny pieces of ice may be formed from the water vapour, and fall to the ground as hailstones. In colder regions the water condenses as so many tiny crystals of ice which we call snow. At night time we have learnt that the surface of the earth loses its heat very quickly, and so the surface of the earth becomes cold and the air close to the earth is not able to hold as much water vapour, so some of the water vapour is left on the surface of the earth in the form of dew. The water is really left in exactly the same way as the water from your hot breath which you breathed against the cold surface of the plate. In cold countries the surface of the earth at night may become colder than freezing-point, and so the deposit is frozen and we call it hoar frost. More dew or hoar frost is usually found on clear nights than on cloudy nights, for clouds prevent the surface of the earth from cooling so rapidly. When water vapour is condensed but remains suspended in

the air near the surface of the earth like a cloud or a mist or a fog

(c) *The Pressure of the Atmosphere*—Have you been out doors when a strong wind is blowing? Sometimes we say that the wind is so strong that it nearly blows us over and it can sometimes do great damage. You see from this that air in motion can exert pressure, and although we do not really feel it, the air is pressing down on us all the time whether it is moving or not. Wherever you may be when you read this, you will have pressing down upon you a column of air about 200 miles high (Although you do not feel it this column of air is exerting a pressure equal to 15 lbs on every square inch of your body, both inside and outside.) You know that a motor tyre or a bicycle tyre does not burst when it is made to stand a great pressure of air inside. In the same way your body is made to withstand this pressure and you do not notice it. But if you climb high mountains where the air is thin you will find it very difficult to breathe. No one has ever yet climbed to the top of Mt. Everest, the highest mountain in the world, because of the great difficulties in climbing to such great heights. To get enough air to breathe. We have already covered the atmosphere to a pile of blankets keeping the earth warm. You will see also that at the bottom of the pile of blankets there will be the whole weight of all of them, and so the weight of atmosphere or pressure of the air is greatest at sea level. As we climb upwards it steadily becomes less. Now we must have an instrument for measuring this pressure of the atmosphere. The instrument we use is called a barometer, because the Greek word "baros" means 'weight', so the barometer is really a measure of heaviness.

If a glass tube about three feet in length be closed at one end, filled with the very heavy liquid mercury, and inverted with its open end in a cup containing the same substance, the mercury will fall in the tube until its level is about thirty inches above the level of the mercury in

and to This is because the weight of a column of the
 different mercury is equal to and balances the weight
 of a column of air 200 miles high. Now, as the pressure
 of the air varies, so the height of the column of mercury
 varies. When we talk about a pressure of 30 inches or
 of 29.5 inches, we mean that
 the pressure of the air will
 balance a column of mercury
 of that height. On a moun-
 tain 15,000 feet high—like
 Mont Blanc in Europe—the
 pressure is only about 15
 inches. But even at sea
 level the pressure of the
 atmosphere is not the same
 in all places and in any one
 place it varies from day to
 day. Perhaps you have a
 barometer at home and you
 tap it to see whether the
 mercury is rising or falling,
 that is to say, whether the
 pressure is increasing or de-
 creasing. There are several
 reasons for variation in
 pressure. Hot air is lighter
 than cold air, so when air
 is heated it begins to rise
 and so the pressure be-
 comes less, so when the tem-
 perature is high the pressure is often low. We have
 already learnt that water vapour is lighter than air. When
 air has much water vapour in it, it is usually lighter, and
 thus the pressure is less in rainy weather when the air is
 damp. Then when we look at the earth as a whole we
 find that there are certain belts on the earth's surface
 where the pressure is usually lower than elsewhere. There
 is a belt of low pressure running round the equator, for

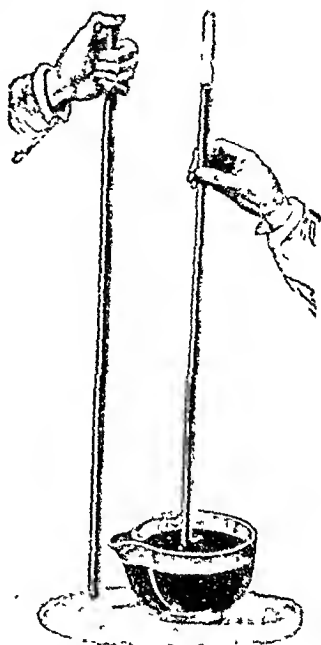


FIG. 55.—Diagram of a barometer

there it is hot and there is great evaporation, so it is nearly always moist. Thus there is a hot, moist mass of low pressure. You have learnt that land loses heat much more quickly than water. And so in the winter the interiors of the great continents and land masses become very cold indeed, and naturally the air over these land masses is also very cold. And so in the winter we find great masses of cold heavy air over the continents of Asia and North America. In the summer these same land masses become very warm and the air over them warm also, because warm air is light the pressure over the land masses in the summer is also much less. We shall see presently what happens as the result of this.

(d) *Wind*—Wind is the air in motion and winds are caused by differences in pressure. The wind always moves from places of high pressure to places of low pressure. In this country we can never be quite sure from what direction the wind will be blowing to-morrow or the next day (notice that we always name a wind after the direction from which it blows, so that the south-west wind is a wind blowing from the south-west). But there are other parts of the world where the winds blow very regularly, almost throughout the year, from one direction, indeed, we may say there are three classes of winds—(1) the regular winds; (2) the periodic winds, which in some places blow for definite periods, and (3) local winds, or irregular winds.

Regular Winds—Let us take first the regular wind systems of the globe. You have already learnt that round the equator there is a belt of low pressure and great heat. Naturally the winds blow towards this low pressure belt. In the Northern Hemisphere, owing to the movement of the earth, we find the winds blowing from the north-east and in the Southern Hemisphere from the south-east and so we have what are called the Trade Winds, the North-east Trade Winds and the South-east Trade Winds. These winds are usually very regular and constant, especially over the sea, but you must notice that the position of the winds changes slightly. During our hot

at is, in June and July, when the sun is shining over the Tropic of Cancer, that is, north of the Equator, the low pressure belt of the equatorial region is north of its average position, and so at this season of the year the Trade Winds are blowing farther north than is the case at other seasons; similarly in our winter in December and the months near, then these winds are south of their average position. The Trade Winds thus blow mainly within the Tropics and are especially noteworthy over the sea and on lands adjoining the sea. Notice

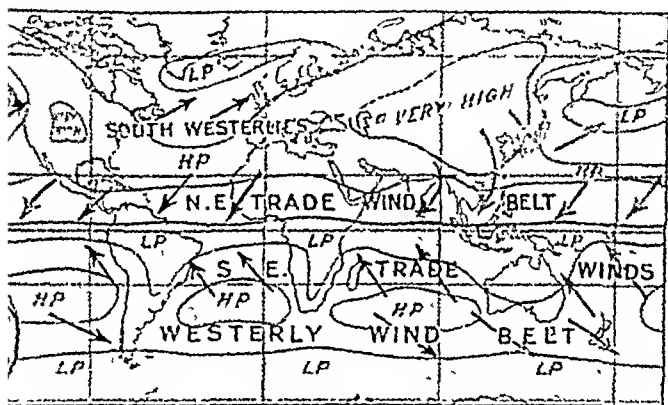


FIG. 59 —The regular wind belts of the world (in January).

that they blow in each case from the east, so that they are felt on those lands which are on the eastern side of the great continents in equatorial regions—along the east coasts of America and of Africa, Asia and Australia.

Then in the Temperate Zones the winds blow not nearly so regularly but usually from the west, and we call these winds therefore the "Westerlies." In the Northern Hemisphere we have the south-west winds, or South-west Anti-trades as they are sometimes called. In the Southern Hemisphere they blow from the north-west. Notice from a map of the world, or from the globe, that in the South

Temperate Zone there is a tremendous amount of water and so over this sea we find the winds blow regularly, but in the Northern Hemisphere are land masses and so the south-westerly winds are less regular. The British Isles really lie within the path of these winds, and so our most important winds do blow from the south-west.

Periodical Winds —Of periodical winds there are some which blow just for twelve hours and are found in places

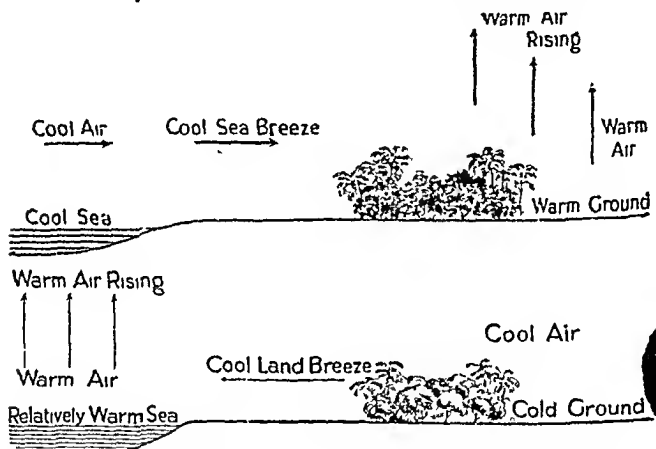


FIG. 60 —Diagram showing the course of a cool sea breeze by day (upper diagram) and a land breeze by night (lower diagram).

near the sea. We call these winds land and sea breezes. For during the day the land becomes heated up more quickly than the sea. The air over the land is therefore heated too and becomes light and rises. A cool sea breeze blows in from the sea, because this is the cool air blown in to take the place of the warm air which has risen over the land. Many places on the sea coast would be very hot indeed if it were not for this cooling breeze from the sea. But during the night the land cools more rapidly than the sea, and for some hours after sunset the air over

is colder than over the sea; with the result that heavy air from the land flows out to the sea as a local breeze.

1) *Continents.*—If you could imagine a great mass of land, as a continent, becoming greatly heated during the summer, you will see that the air over it will become hot and will rise and that cooler air is likely to blow in from the ocean to take its place. This is really the same as a sea breeze which we have just explained, except that instead of blowing for twelve hours the cool wind from

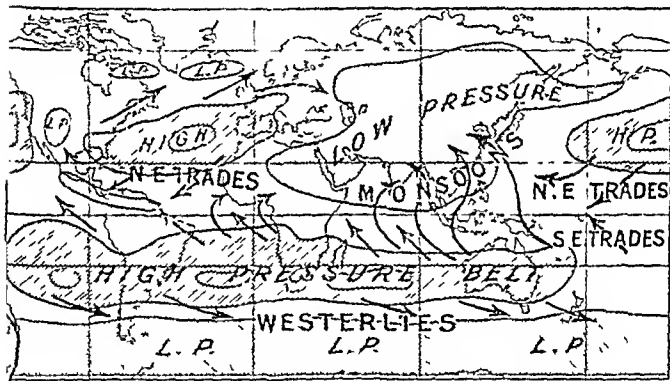


FIG. 61.—The regular wind belts of the world (in July)

the ocean blows for the hot half of the year, possibly for six months. Such a wind is called a monsoon. In the winter the continental mass becomes very cold, and so cold, heavy air over it blows outwards to the sea, there are outblowing cold winds at this season. The vast land mass in the world is Asia and the monsoon winds are most important round the continent of Asia, especially in the south-east and east. Now you have learnt about the pressure belts and the wind systems of the world, try and study Fig 61.

Of the local winds the most important are those which

are associated with cyclones or depressions. You have all listened to the weather which is given out every day over the wireless, must have heard the announcer say at some time

"There is a depression over the north Atlantic which is approaching the British Isles, moving slowly eastward." In all parts of the world, but especially in temperate regions, there are local areas of high pressure surrounded by regions of low pressure, or small regions of low pressure in a belt of high pressure. Naturally the winds blow towards the centre of a low pressure system or depression: but at the same time they blow round this centre owing to the movement of the earth in an anti-clockwise direction, that is opposite to the direction followed by the hands of a watch. An anti-cyclone usually, in this country, brings us fine weather, sometimes cold and still and foggy weather in winter, the winds blow round and away from the centre in the same direction as the hands of a watch, that is, in a clockwise direction. You can look upon these little eddies and whirls in the main current of the air, especially in the belt of the westerly winds, as being like the eddies or the whirls that you see in a stream or a river which is in general flowing on its way towards the sea. In this country cyclones or depressions with inblowing winds usually bring wet, stormy weather, cold in summer, but may be mild and muggy in winter.

(e) *Rainfall*—We have already learnt how the air becomes saturated, and when saturated air, or moisture-laden air, is cooled condensation takes place, and so we get rainfall, or if it is cold, snowfall. We can use the word precipitation to cover both rainfall and snowfall. Air obtains its moisture by evaporation from the surface of large areas of water such as the ocean. Air which comes from land regions is usually dry.

There are several ways in which moisture-laden air can be cooled to give up its moisture as rainfall. It may be cooled by rising upwards into the upper and colder regions of the atmosphere, or it may be cooled by being blown as

ed to colder regions. Actually, we can distinguish four
erent kinds of rainfall

1) *Convictional Rain*.—In very hot regions, such as near

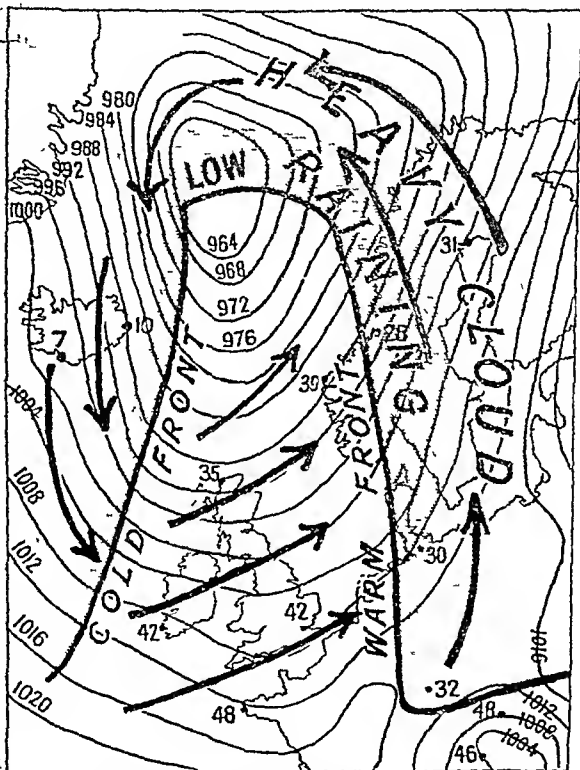


FIG. 62 —A cyclone over the British Isles

fine lines are lines of equal pressure, the figures, such as 32, etc., are temperatures, the arrows show wind.

he equator, evaporation is very great, and the moisture
o formed is lighter than dry air and so it readily rises
t soon expands, cools, and rain falls, and thus the rain
alls on exactly the same area, or nearly the same area, from

which the moisture was derived. This type of rain occurs almost every day in countries near the equator and explains the very heavy rainfall to be found all the year round the equatorial belt.

(2) *Relief Rain* — When wind blowing from the ocean and so laden with moisture reaches a land mass, the wind, if there are mountains or hilly areas, is forced to rise, and in rising it becomes cooled and rain results. We see that such rain is closely associated with the physical features, or relief, of the land, and so we call these relief rains.

(3) *Cyclonic Rains* — We have already learnt that in a cyclone or depression the winds blow towards the centre and in the same time round it in an anti-clockwise direction. In the centre there is a low pressure area with ascending

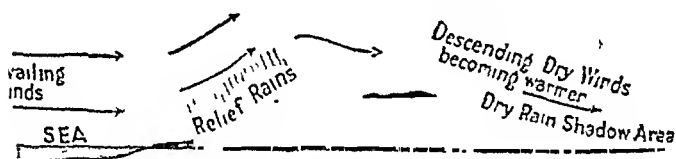


FIG. 63 — Rain shadow area.

air currents. If the air here is moisture-laden it will rise and will be cooled and rain will fall. Such are the rains we get so frequently in this country, which are associated with these depressions and so are called cyclonic rains.

(4) *Thunderstorm Rain* — Then there is the rain which we get from very sharp local storms such as thunderstorms.

When a moisture-laden wind is forced to rise over a mountain range it must be cooled and is sure to lose some of its moisture. The higher the mountains, the more moisture is lost. When the wind has finally passed over the range it is almost a dry wind, further, when the wind drops to the lower ground it is warmed rather than cooled, so it becomes a thirsty wind and not one which is ready to shed any of its moisture. That side of a mountain

high faces the rain-bearing wind and receives the rain. We call the windward side, the dry side we call the leeward side. The land which is kept dry in the rain shadow of a mountain range is said to be in the "rain shadow" of the mountains. The rains which fall on the leeward side are mainly convectional or cyclonic rains. The east coast of Scotland is in the rain shadow of the Highlands; the plain of York and the East Riding are in the rain shadow of the Pennines. On the rainy west side of England, the Lake District the rainfall is over 100 inches, on the east coast in Essex it is less than twenty-five. Similarly, a large part of the plateau of India is in the rain shadow of the Western Ghats, and so receives very little rain.

Rainfall is measured by means of a rain-gauge. All the rain which falls over a certain area passes into a funnel and is collected into a jar where it cannot evaporate, and where it can be measured. When we say that the rainfall for one day has been 2 inches, we mean that if all the rain which fell that day had remained where it fell, it would have formed a layer 2 inches deep. In nature, as you know, as soon as the rain falls, some of it sinks into the ground, some of it evaporates, and some runs into the streams and rivers. That is why we use a rain-gauge to measure the actual quantity which fell. Just as in recording temperature we took the readings every day, so we do with the rain-gauge. We note the amount which falls every day, and then by *adding* up the amounts for each day we get the monthly amounts. The most important figures are the *monthly averages*.

Rainfall Maps.—On a map of any country we can mark the monthly or yearly averages. Sometimes it is better

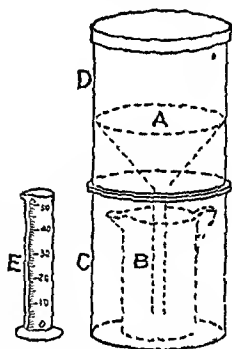


FIG 64—Picture of a rain gauge

to use the amount for a season. such as the rain. Fig 65 is a map of the world, which shows you the rainfall for the months of June to August, when we have it in England. On any rainfall map we can go through places having the same rainfall; these are called "isohyets." You must remember that the wind changes gradually. You cannot have one rise, and rainfall of more than 80 inches, and the next see that than 40. There must be an area between, features only a narrow strip, having a rainfall from 40 to 80 inches.

Remembering Rainfall — You cannot remember what in a figures for rainfall, it is too difficult.

Try to note.

(a) The time of year when most rain falls

(b) Whether the rainfall is good, moderate, poor, or very poor. In the tropics above 80 inches is good, much higher it may be excessive), 40 to 80 moderate, 15 to 40 poor, and below 15 very poor. In temperate regions both evaporation and rainfall are less. Above 40 inches is good, 15 to 40 moderate, 5 to 15 poor, below 5 very poor. It is largely owing to differences in evaporation that a winter rainfall of 6 inches in the temperate areas of Australia is of more value than a summer rainfall of 12 inches in the Australian tropics.

Weather

We have now learnt quite a lot about the atmosphere. We have learnt about pressure and its measurement, about temperature, winds, moisture, rainfall, etc. If we think of any one day, all these things put together make what we call the Weather. Sometimes one seems more than the other and we can say it is wet weather today or perhaps it is very cold weather, or cloudy weather. We can talk, too, about the weather for the week or a month. Sometimes for a whole week we may have stormy weather. In tropical regions such as India the weather does not change very quickly. In the middle

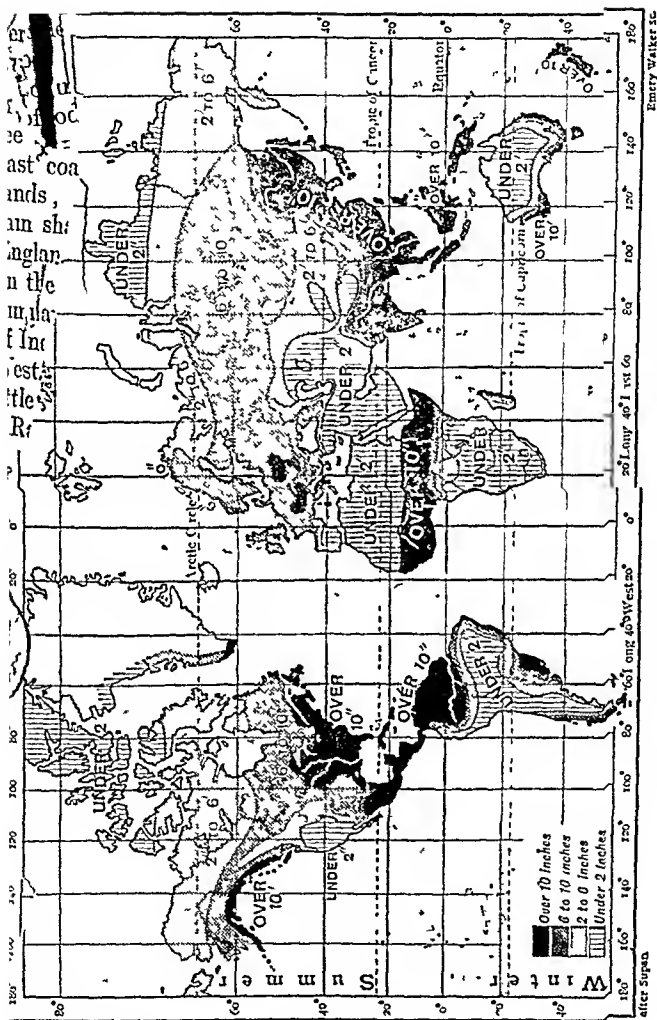


FIG. 65.—Rainfall map of the world (Northern Summer).

of the dry season there may be a wet period, but not often. In other countries, including the British Isles, every day may be quite different. In our own town, one day may be wet and cold, and next day clear, sunny and quite hot. In such countries everybody is very interested in the weather, and many of the newspapers publish every day little maps (called weather charts) showing the state of the weather. On the oceans sailors have to watch the weather for storms, and it is important to farmers in all parts of the world.

Climate

(Climate is the average of the weather.) We must be quite sure we understand what that means, because climate is one of the most important subjects in geography. In England we have summer and winter, but rain falls at all seasons of the year. At the same time, the summers are never very hot nor the winters very cold. Countries round the Mediterranean Sea have quite a different type of climate. (In the case of this type of climate we can divide the year into a short, mild, moist winter, and a long, hot, dry summer.) Every year there are these seasons. In some years the rain during the winter or rainy season is very abundant; in other years not nearly so much rain falls. But that does not make any difference to the truth of the statement that each year has its wet winter and dry summer. Sometimes we may have a hot day in the midst of the winter, and we can say that the weather for that day is exceptional. But one exceptional day does not alter climate, because the climate refers to the normal or usual condition of the weather. If we observe every year carefully for many years the amount of rain which falls during any particular month, or during the rainy season, we can get the *average rainfall*; in the same way we can find the average temperature, pressure, humidity, wind direction, etc. All these averages—for a month, for a season, or for the year.

becomes warm, and so it gives a warm current of air. Perhaps the most famous and most important of all the ocean currents is the Gulf Stream and its continuation, sometimes called the North Atlantic Drift. This stretch of warm water comes across the North Atlantic Ocean from the south-west and passes by the British Isles, and on past the coast of Norway. It is largely as the result of the warm air from over this drift of water that our climate in the British Isles is comparatively mild. On the other side of the Atlantic Ocean in the same latitude is the coast of Labrador and Newfoundland, which is bathed by a cold current, the Arctic Current. So great is the difference as a result that the seas along the coasts of Labrador and Newfoundland are frozen every year. The sea is entirely blocked by ice, whereas ice never forms in the sea round the British Isles. Cold currents, such as the Arctic Current, often bring numerous icebergs, which may be very dangerous to ships. Where cold and warm currents meet great fogs are often caused by the mixing of the cold and warm air over the two currents, whilst in other places where cold and warm currents meet the mixing of the air causes violent storms. Study the maps very carefully and notice the principal currents of the oceans of the world. Mark again at each one whether it is a hot current or a cold current, and study the maps in your atlas which show you where the sea is frozen over in winter, and you will see how very largely this is caused by the influence of ocean currents.

SECTION VI

THE REGIONS OF THE WORLD

WE now know something of the great geographical factors, and, as we learnt in the first section of this book, these geographical factors make their influence felt on the

type of tree or grass which will grow and on which ^{not} which can be grown by man and also on the wild ^{tish} I which can exist or on the tame animals which ^{n to} kept by man. You do not find camels or giraffes ^{day cl} in fruit orchards or the fields of this country, and ^{very b} be very surprised if we found a crowd of monkeys ^{he n} walking through one of our English woods. But ^{weather} were walking through forests in India we should ^{the ocean} unless we were unlucky, to see some monkeys playing there. Again, we often see sheep in this country, but we do not see sheep feeding on the forest trees because they cannot climb the trees to get the leaves. Instead we find the sheep feeding on the hillsides, where they can nibble the short grass. So each type of vegetation has its characteristic animals, and when the natural vegetation has been cleared away by man there are certain crops, and certain crops only, which will grow, and there are certain animals, and certain animals only, which can be kept. If we study the world we find that we can divide it into a number of great regions. These regions are determined mainly by the type of climate which is found. We have learnt something about climate and we will now study each of these great regions in detail.

1 The Regions of the Hot Wet Forests ✓

We have learnt that round the equator there is a belt where the temperature is high throughout the year, where the air is always damp, and where there is abundant rainfall. Days and nights are both hot and so there is very little daily range of temperature. There is no summer and no winter, for it is hot throughout the year and there is indeed practically no difference between the hottest months and the coldest months. The air is nearly always moist and it feels steamy, just like being, as we say, in a hot-house. There are many parts of the world where it gets hotter than it does in these regions near the equator, but there are no other regions where it keeps so equally

becomes es. There are the climbers which climb up and perhaps their sunlight by being dependent upon their bigger ocean runner brothers. Often the climbers are so heavy and sometimes so that they will kill the tree by which they climb. If warm & twisted coils of their stems lie scattered about from the ground and make it difficult to walk through the forest. There are other plants such as ferns and orchids, of the wet get their share of the sunlight by growing on the

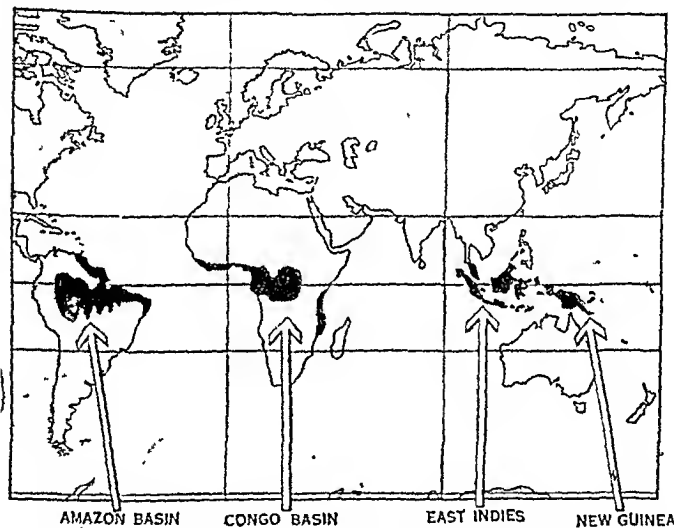


Fig 68 —Map of the world showing the equatorial regions

branches of the bigger trees. So in the hot wet forests we find three types of vegetation, namely (1) the big trees, (2) the climbers, and (3) the epiphytes, as we call them, which live on the branches of the larger trees. The carpenter, dull and gloomy inside the forest that very kinds of trees all live there. If we want to see the real particular kind we must imagine ourselves as belonging to a the forest and pick monkeys and make our way to the so far overhead that we shall find many animals and other

creatures which have been specially fitted by nature to live in the tree tops. There are our friends the monkeys who can jump very easily from bough to bough and very rarely lose their foothold. There may be flesh-eating animals belonging to the cat tribe who move stealthily along the branches and try to catch the nimble monkeys. If we could penetrate these great forests we should have to go carefully for there are poisonous snakes lurking among the branches. We might be surprised to see some creatures which we never suspected could climb trees; for example, we should see some frogs, with curious suckers on their feet which enable them to move without falling off. Then sitting amongst the higher branches there would be gaily coloured birds, parrots and parakeets, and a whole host of others, as well as a wealth of insects getting the honey from the gaily coloured flowers of the climbers. In these great equatorial forests we might look for miles across a sea of green leaves without any break in it at all.

Now where do we find such forests growing in the world? The hot wet forests and the equatorial type of climate, as it is called, are found as a broad belt on either side of the equator stretching strictly (except where there are mountains and plateaus) from about 5° North to 5° South, but gradually fading away on either side so that some forests of this kind are found as much as 10° away from the equator. There are three enormous areas in the world of this type. There is the great area of the basin of the river Amazon in South America, which lies largely in the country of Brazil; then there is the large area which forms the greater part of the basin of the river Congo in Africa, and then there are those islands which lie to the south-east of Asia called the East Indies, as well as part of the mainland of Asia itself. Let us take a visit to these regions and see if ~~it is nearly~~ something about the people. If we ~~go~~ ^{go} ~~going~~, as we say, America, the only way of travelling 'of the world where there is to follow some of the broader ones near the equator, is one of the largest rivers in the world it keeps so equally

a thousand miles up this river from the sea in a great steamer which has brought us across the ocean, then we can penetrate hundreds of miles farther by smaller boats, but in whatever direction we went we should see very few houses and very few towns. for what is man to do in such a region? He cannot very well live in the tree tops as the monkeys do, and if he tries to live on the ground he will find it always damp and unhealthy, so he builds his small settlements often by the river bank where there is some light and air to be had. But the great rivers often overflow their banks, and so it is difficult to find a place which will remain dry. The small numbers of South American Indians who live in the Amazon forests are thus very poor people, and often have to rely for their food on the few fruits which they can gather or roots which they can dig up. You may say, why do they not cut down the forest and grow something useful? But think what a tremendous task it would be for these primitive people to cut down the giant trees of the forest and clear a patch of land. Even when they have done so weeds would grow up very quickly and would choke any crops they tried to grow. Perhaps, too, the heavy afternoon rains would even wash away the soil itself from their crops and leave nothing but the bare rock underneath. Or, again, the rivers might overflow, as they often do, and wash the crops out of the ground. So this great region of the Amazon Basin remains undeveloped and is likely to remain so for a very long time. You might think the timber from the trees would be very valuable, and so it is. Many beautiful hard woods, rather like mahogany in character, can be obtained, but for building our houses we prefer a soft wood which can be sawn easily, and not one which is so extremely hard that it cannot easily be cut into beams and planks for the carpenter's use. Then there are thousands of different kinds of trees in these hot wet forests, and if it is one particular kind we want it is often difficult to go through the forest and pick it out. The crowns of the trees are so far overhead that we cannot see the leaves to

the particular tree we want. But there have been some very valuable products that have come out of these forests. In the days of old the natives of the Amazon forests used to go in and discovered a tree yielding a valuable juice from which rubber could be made, but they have cut down most of these trees now and there is very



[Courtesy of the Rubber Growers' Association]
FIG. 69.—Tapping a rubber tree.

little of this wild rubber left. A very similar kind of substance called balata is still obtained in parts of South America. If we go for a moment to the hot wet forests of Africa we find the forests there are not quite so thick and it is possible for some plants to grow on the ground. The river Congo is not quite as large as the Amazon and does not over-

flow its banks so easily, and so in some places it has been possible to make cuttings and to grow crops; but, again, in the denser, wilder parts of the Congo forests it is very difficult indeed for man to live, and it is here that we find a very curious tribe of people called Pygmies. Owing to the absence of light and air they are very small people, often not much more than four feet

high. They have realised that the monkeys are best off living in the trees where they are nearest to the sunshine, and so the Pygmies have built for themselves huts, often high up in the branches of trees, and they live almost like monkeys. They are very timid people, and travellers through the forest often find it difficult to find them, but they are always very pleased with a present such as a bunch of bananas, for it is difficult for them to get their food. When we come to the hot wet forests of Asia there are still very many wild parts, for example, in the islands of Borneo and Sumatra, but there are other parts where the white man has come along, has cleared away the forests, has overcome the difficulties, and has grown crops for himself. It is said that the equatorial climate is a good servant but a bad master; it is a bad master to those primitive peoples who have not yet learnt to cut down the forest and to grow crops of their own. But to the white man there are many of these equatorial lands which have yielded great profit. When he has cut down, or burnt down, the forest he protects the ground very carefully by growing a low crop which is called a cover crop, so that the soil is not washed away by the rain. The crop binds the soil together very quickly and prevents the growth of weeds. It is in these regions of south-east Asia, particularly in the peninsula of Malaya and the island of Java, that we find the great rubber plantations of the world. The rubber tree is a native of the South American forests, and when it is cultivated it is not necessary to



[Photo L D Stamp

FIG 70 —Cocoonpods growing on the tree

cut it down in order to obtain the rubber juice: this is obtained by just tapping the tree as you see being done in the picture. Another plant

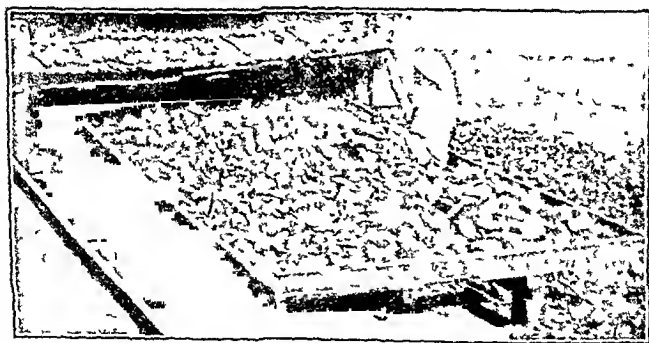


[Photo F S A]

FIG. 71 —The fruit of the oil palm

which thrives in the equatorial regions is the cocoa tree. The cocoa is a small tree growing to a height of 15 or 20 feet, and bears some 20 or 30 pods per year on its stems or main branches. Inside these are the cocoa beans, which are taken out and ground to form our cocoa, from which, of course we also make chocolate. Most of the cocoa of the world is now obtained from the fringe of the equatorial belt, from Africa and

South America, and Central America. In Africa grows the Gumea oil palm, and the oil obtained from the fruits



[Photo L D Stamp]

FIG. 72 —Coconuts—cracking open the nuts and spreading them out to dry

of this palm form the basis of many of our soaps, or of margarine which is sometimes used instead of butter. On

the margins of the hot wet regions, especially round the coasts of islands, grow the coconut palms, whose nuts, again, yield a valuable oil. Where there are large flat areas that have been cleared in the equatorial regions—for example, as in Java and in Malaya—the great food crop of the people is rice; and because it is hot throughout the year it is possible for the rice crop to ripen at almost any season, and it may be possible to get several crops from one piece of land during the year. For where man has conquered the difficulties of the hot wet forest climate he can grow very many important crops. Another one we have not mentioned is manioc, from South America, from which tapioca can be made.

2 The Tropical Forests and Tropical Grasslands

The tropical forests and tropical grasslands are found in hot countries, that is, countries between the tropics but outside the equatorial belt. In the equatorial belt the sun is shining directly overhead throughout almost the whole year; but farther north, or farther south, there is one season of the year which we may call the summer when the sun is shining almost overhead, and the other season of the year when it is not nearly so hot. We find that in these regions there are really three seasons. There is what we call the cool season—we cannot really call it the winter because it never gets cold—it is also usually a dry season. Then, in the Northern Hemisphere, about March or April, the sun begins to shine much more nearly vertically (it is over the Tropic of Cancer exactly on June 21, and over the Tropic of Capricorn in the Southern Hemisphere exactly on December 22), and during this time the land becomes very much heated. Much higher temperatures are found in tropical countries at this time of the year than ever occur in the equatorial belt. Because the air is hot it is thirsty and keeps on drinking up more and more moisture as it gets hotter, so there is very little chance of rain falling. But about

May or June this hot air begins to rise and cool air begins to flow in from the ocean to take its place. This cooler air brings with it moisture, and as this moisture-laden air begins to rise over the heated land it is cooled, and so we get in the latter part of the hot season or summer the rainy season. The rain comes down heavily in the Northern Hemisphere in June, July, August and September, but begins to dry up later in the year. In places near the sea, and near the equatorial belt, the rainfall is often very heavy, and just on the margin of the equatorial belt the dry season is only short, but the farther away from the equator the less the rainfall usually becomes, the longer the dry season. Let us see now what sort of plants and animals we should expect in these regions. Where the

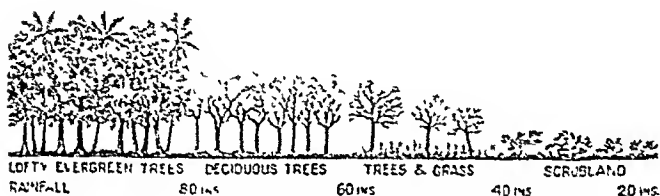


FIG. 73 — Diagram of the vegetation of the tropics

rainfall is very heavy, or where the dry season is only short, we shall find that it is not very different from the equatorial regions, and so here we find hot wet forests. There are some trees however, which cannot really stand even a short dry season, and one of these is the rubber tree, so we do not get very much rubber growing. But as we get away from the equator and the dry season becomes longer, or the rain becomes less, we find that trees will still grow, but they have a hard life during the very hot season and the early part of the year. The water evaporates so quickly from the leaves of the trees that often we see them wilting, as we say, and so most trees protect themselves against this period by losing their leaves. There are, then, deciduous trees, as they are called, which, instead

of resting and losing their leaves during the winter as our trees do in this country when it is very cold, lose their leaves in the hot season as a protection against the great heat. Just at the season of the year when it is hottest it is often very disappointing to go through one of these forests and find there is no shade to be had from the leafless trees. Just before the rains break, the trees burst out into flower and soon afterwards into beautiful green leaf. But in the drier parts of the tropical lands large trees will not grow, only very poor small bushes What do we find instead? We find that the rain comes in the warm season of the year, and this is just right for plants which spring up very rapidly every year and so reach the time when they can flower and fruit. Now you all know what happens in the springtime in England—how quickly the grass in our gardens grows, and how the seeds which we have planted earlier in the year begin to sprout so that soon we have borders of beautiful flowers. That is exactly what happens over large areas in these tropical lands. The chief vegetation is grass, and in the spring of the year, or early part of the summer, when the rain first comes, grass springs up very quickly and often reaches great heights. So in some of the tropical grasslands the grass may be six, ten or even fifteen feet high, so high that it is right over the heads of men who walk through it. In the latter part of the year the grass may become dry and brown, a period when it dies away before the fresh green grass comes up again the following year. As we get into still drier regions so the grass grows more poorly, and gradually the grasslands fade into desert tracts where there are only just tufts of grass and perhaps a few spiny bushes. Although, therefore, we find forests on the wetter or warmer margins of the tropical lands, the larger part of the whole is covered with grass, and so we often talk about the tropical grasslands. Tropical grasslands cover enormous areas in Africa, particularly in the region called the Sudan, so the type of climate about which we are now talking is often called the Sudan type of climate.

We find it also in South America in the grasslands of the Orinoco and the grasslands south of the great Amazon Basin forests. The Tropical Climate is also found in the West Indian islands and in Central America; but there, because the sea is near, there is not the same difference between the hot dry season and the rainy season, and most of these islands get some rain throughout the year, and for that reason favour the growth of trees even more than grass. Over large parts of Africa there are scattered

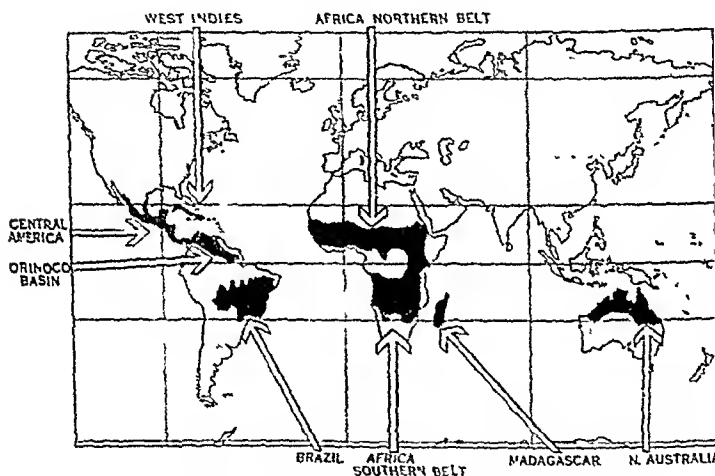
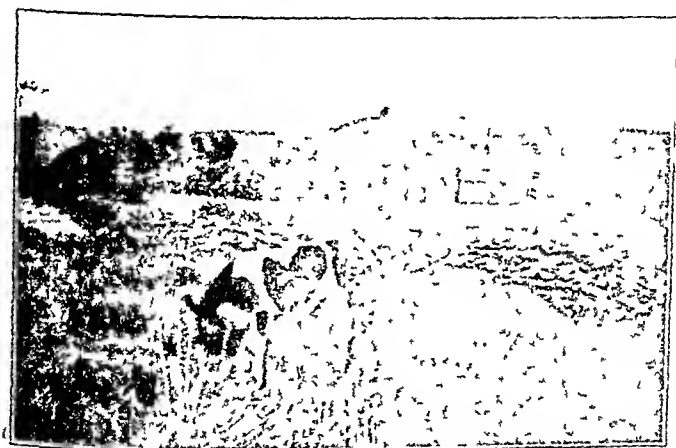


FIG. 74.—Map of the world showing where the tropical climate is found

trees amongst the grasslands, and this type of land with scattered trees is often called savanna, so the savanna lands are really the same as the tropical grasslands. We find these savanna lands again in the northern tropical belt of Australia.

Now let us think for a minute what sort of animals we should expect to find in these lands. In the forests, of course, there will be monkeys and animals which can live in the trees just as we found in the equatorial regions,

but when we get to the grasslands it is not much use being a monkey and being able to swing from tree to tree to go to bough if there are no trees to climb. We must recall that the animals live mainly on the ground. There are two groups of animals. We have spoken of the group which the grass grows rapidly and it is not in this group. We should find a group of animals which live in this rich grass. These are the grass-eating animals and I do not know if you have all heard of the numerous herds of antelope.



1120 F.C. Stamp

FIG. 75 — A small native village in tropical Africa

example, which are still very common in the grasslands of Africa. Then, lurking amongst the long grasses we should expect to find animals such as the lion and the leopard, flesh-eating animals which are just waiting an opportunity to catch the grass-eaters. It is therefore a hard life for the grass-eating animals, and so nature has helped them in two ways. The grass-eating animals usually take a meal of grass very quickly indeed while there is no enemy in sight, and then they go away to some quiet spot where they are safe from their enemies and

not yet really very many people. There is plenty more room for the keeping of herds of cattle and the cultivation of crops. One difficulty in keeping cattle is that there are numerous insects, some of which carry disease from which cattle die. You have probably all heard of the tsetse fly of Africa; and in those belts of Africa where the tsetse fly is abundant it is still impossible for man to keep large numbers of cattle. The chief food crops of tropical lands are corn or maize and, in the drier parts, the grains called millets which we have just mentioned. Sugar-cane is an important crop. In the very wet lands where there are flat lands that can be flooded it is possible to grow rice. One of the most important crops not grown for food is cotton. We shall say something more about cotton presently, but remember that it can be grown in these regions in Africa. No doubt, too you have all tasted monkey-nuts ~~or~~ pea-nuts, a better name for which is ground-nuts. These are not really grown for supplying us with nuts to eat, they are grown because from the nuts is obtained a very valuable oil, and this vegetable oil is used, like so many others, for the manufacture of margarine and soap. The monkey nuts form on the roots of a small plant rather like a pea which will grow in the drier parts of the tropical lands and is fast becoming of very great importance.

3. The Tropical Monsoon Lands

We have already learnt what a monsoon is and how it is caused, and we mentioned that it is particularly with the greatest land mass of the world, the great continent of Asia, that monsoons are connected. Monsoon winds and the rains which they bring may be found within the tropics of quite hot countries, or they may be found in countries like China and Japan, where it gets very cold in the winter. We are going to talk first about the warmer monsoon lands, and by far the most important of these is India. The same type of climate is also found farther east, in

Burma, in Siam, in Indo-China, and the southern part of China itself. There are really three seasons in the monsoon lands. We cannot again talk about winter, because it never really gets cold enough to call it winter. There is the cool season, which is usually dry, when the sun is shining vertically to the south of the equator, and in India the cool season lasts from about November to the end of February or March: then in March, April and May, as the belt of vertical sunshine is passing northwards, the land gradually

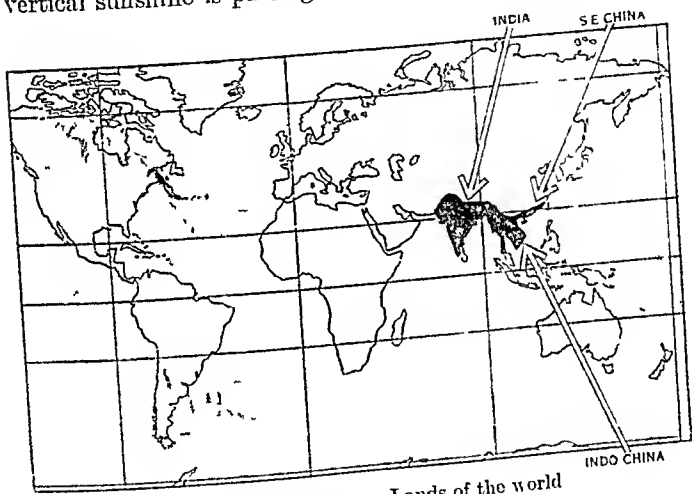


FIG 77—The Monsoon Lands of the world

becomes hotter and hotter and in most parts of India March, April and May are very hot months indeed. In this country most of you look forward to your long school holidays which you have in August and the beginning of September so that you may enjoy the English summer, but the boys and girls in India have their holidays much earlier, in March or April or May, because it is so hot at that season of the year that it is really impossible to do any work in school at all. Then the land mass of India, especially northern India, becomes so heated that the hot air rises,

work of ploughing the flooded fields is often carried out by water buffalo, and the little seeds are often planted in a small field called a nursery, and when the plants are a few inches high they are taken out and planted in the larger fields by hand. Thus in India the planting of the rice takes place during the rainy season. As the rains cease the water gradually dries up and towards the harvest-time, which is in December or possibly January, the fields are

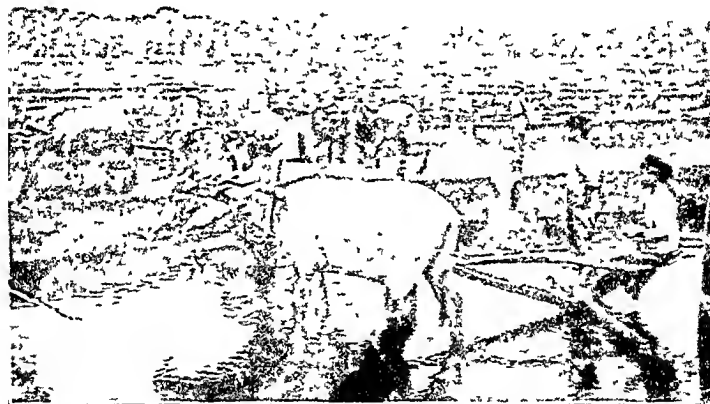


FIG. 78.—Ploughing rice fields with water buffalo.

dry and the rice can be cut in very much the same way as we cut wheat or oats in this country, except that it is usually reaped by hand and not by machine. In India rice covers the greater part of the flat lands of the delta of the great river Ganges, as well as the flat lands along the east and west coasts. As we pass into the drier parts of India so we find that together with the rice fields there are fields of millet and maize, and possibly also of sugar-cane.

(as in Assam). Then there is the island of Ceylon which lies to the south of India. Now Ceylon really has a climate which is halfway between that of the monsoon land of India and the hot wet forest of the equatorial belt. In Ceylon we get a lot of rubber cultivated as well as some cocoa and coconuts, whilst in the hills tea is a very important crop.

Warm Temperate Lands

We now leave the lands which lie within the tropics and turn to those that are just outside. There the summer heat is not quite so great and the winters are often considerably cooler. There are many lands in the world which can be described as warm temperate, but they do not always have the same type of climate. Let us take first of all the temperate monsoon countries of which China and Japan are the two main examples. They have a climate like that of India in that there is a cool season which is dry, a hot season which is dry, and then the rainy season, but their cool season is very much colder. Indeed, in the north of China, it is very cold indeed, much colder than our winters. Much of Japan is covered with snow in the winter time, and in the north of China it is so cold that the rivers are frozen over in the winter. But the summers are very much hotter than our summers and nearly all the rainfall comes in the summer months. In those parts with a warm wet summer it is possible to grow rice, as in central and southern China and the southern part of Japan. Farther north, where the summers are not so hot and wet, we get millets and wheat grown instead. Cotton is also a crop of great



FIG. 80.—Cotton—showing method of growth

importance. Perhaps the Chinese is not so fortunate as the Indian in his climate and in his country because there are large stretches of barren mountain, but the Chinese have learnt to make the very most of their land. The Chinese may be called farmers, and yet they are not really farmers; they are exactly what we should call gardeners, that is to say, they cultivate each little tiny piece of land by hand and they grow many different kinds of vegetables, as well as rice and other grain; they also rear animals, notably the pig and chicken. But you will learn more about China and Japan later.

Let us now look at another warm temperate country which is rather different, and that is the south-eastern part of the United States of America. It is the part which is often called the Cotton Belt, for it is here that nearly two-thirds of all the cotton produced in the world is grown. Here the winters are cool, or even cold, but there is a certain amount of rainfall even in the winter: but the main rain comes in the spring and the summer, and less in the autumn. It is in this part of the United States that most of the 10,000,000 negroes, whose great-great-grandparents were many years ago brought over from Africa as slaves to work on plantations, now live. They are, of course, no longer slaves, they work for wages just like white men, but they can work in climates which are really too hot for the white man to work in the fields. We ought first to learn something about the way in which cotton is cultivated before we can understand what happens in the Cotton Belt of the United States. In these warm temperate lands of the south-eastern United States cotton is king. If you look at a physical map of North America you will see that there are no mountains to separate the southern United States from the cold north, and so in winter cold winds sweep down from these northern regions and the winters are often very frosty. So the farmer has to wait in the spring until after the last frost has disappeared before he sows his cotton seed. For the cotton plant is one which is at once killed by a sharp frost. But the spring is

warm and light rains soon help the cotton plant to grow, and a little later the wide fields are ablaze with the bright yellow flowers of the cotton plant. The pleasant showers of rain during the summer help the growth, the temperature gets high, higher than in this country, but as the autumn approaches the rain gets less and so when the cotton plant has formed its pods, and these pods burst open to expose the fluffy mass of cotton, there is fortunately no rain that is likely to damage the crop. But as soon, or almost as soon

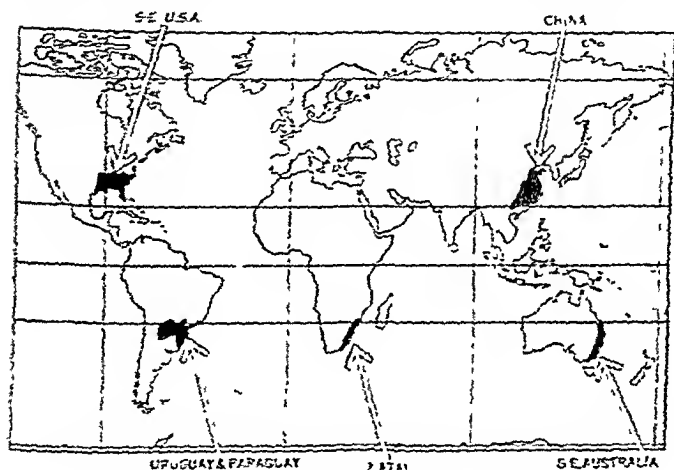


FIG. 81.—The Warm Temperate regions of the world

as the cotton "boll" or pod has burst the cotton must be picked. There is really only one important way of doing this, and that is by hand. In the bad days of old, a long while ago, the work of picking the cotton, and of tending the cotton plantations too, was done by the black slaves. It is still the coloured people, though no longer slaves, who do the work. The men, women, and even children, are all kept busy at the cotton harvest. When the cotton has been gathered in it is taken to what is called a ginnery, because the cotton which we

important one, is the maize crop, which is the principal food crop. Many parts of these warm temperate regions are still covered with forest. There are forests of pine trees which yield the valuable timber we call pitch-pine, and there are also forests of broad-leaved trees. Florida is rather different from the rest of the south-eastern United States. It is too wet, especially at harvest time, to grow cotton, but it has a fine, sunny coast-line, famous for its seaside resorts. No doubt you have seen pictures of Palm Beach, or Miami, on the 'talkies', and probably you have all eaten oranges which have come from Florida.

When we turn to the Southern Hemisphere we find that there are three regions which have a warm temperate climate. There is a region in southern Brazil in South America; there is a region on the coast of South Africa, which is roughly that part of the Union of South Africa called Natal; and there is the eastern coastland of Australia, particularly in New South Wales. In these three regions the climate is practically the same, but it is quite different from that in China or the south-eastern United States. For America, South Africa and Australia are not such big masses, and they do not get so cold in the winter, so the winters in these southern regions are really quite warm. The summers are hot; The rain comes mainly in the summer, when it is brought by the Trade Winds. This mild climate, with a good rainfall and warm sun, favours the growth of trees, and so the natural vegetation of these regions is a good forest, and it may even be enough for the forests to be evergreen, and we see such things as tree ferns and palms growing well. When the forest is cleared crops which like a warm summer, such as the sugar-cane—will grow. Where the forest is too thick, there is often a good growth of grass, and in part of Australia we get dairy farming carried on. In South America—that is, in southern Brazil—on the slopes of the mountains, where there is a very good soil, are the great plantations, and this part of Brazil produces nearly all the coffee of all the coffee consumed in the world.

important area is that around the Mediterranean Sea itself—the countries of Spain and Portugal, southern France, most of Italy, the Balkan Peninsula, Palestine, North Africa. Notice that the eastern part of this region—Syria, Palestine

and Turkey—is rather near to the great land mass of Eurasia, and so this part of the Mediterranean does get rather cold in the winter, colder than most other regions. Then in North America we have a small but very important tract in the state of California. In South America there is central Chile, in South Africa there is the district round Cape Town, in Australia there is the part of Western Aus-



[Photo L D Stamp

FIG. 85 —An Arab school in Aleppo Notice the boys' dress, the flat-topped buildings, and the few small windows (so that the light indoors is not too strong)

tralia round Perth, and farther east the region stretching round Adelaide to Melbourne.) These are all regions with a Mediterranean climate and they can all grow those products that we have just mentioned. That is why we can now buy in our shops raisins and sultanas from South Africa

or from Australia, as well as from the older European countries, and also from California. We must not forget, too, the oranges and lemons and grape-fruit which grow well with this climate and which we get from these different regions. Next time you buy an orange try and find out from where it has come. If we could go to one of the Mediterranean countries in Europe we should probably see several differences between the houses and those in our own country. It gets very hot in the summer in the afternoon, and so in the towns there are often shady piazzas over the pavements so that people can walk along and look at the shops without getting too hot. Then we find that many of the houses have shuttered windows, the shutters let the air through but not the light; and if we went into a small town in Mediterranean Italy or in Mediterranean Spain in summer we should find it very quiet in the afternoon, because most of the people take an afternoon sleep during the heat of the day, or as we call it, a siesta, and then at night-time the whole place wakes up again; and then in the early morning we should find the farmers very busily working out in their fields as soon as it was light and while it was still cool. In many parts of the Mediterranean regions it is quite dry, and so there is not much danger of flooding through heavy rainfall. We find that people even build their houses with flat roofs, or roofs where the water will drain in towards the centre into a rain-water tank; for in certain of the drier parts they may have a difficulty in getting enough water, and so they try and collect some of their own.

6 The Hot Deserts

In the last two sections we have dealt with lands which lie outside the tropics in the warmer temperate regions. We must now return to lands which lie actually along the Tropics of Cancer and Capricorn. If you remember what we have learnt about the regular wind systems of the globe we found that both the Trade Winds and the Anti-

trade Winds, or Westerlies, really start from a belt of high pressure just outside the tropics, so that winds in these regions are nearly always blowing outwards. They do not blow from the ocean and bring rain, and so we find a great belt of land along this high pressure belt which is very dry at all seasons, so dry that the result is a great tract of desert. The largest deserts are where there are the largest land masses, and so you see that an enormous desert which we call the Sahara stretches right across Africa from

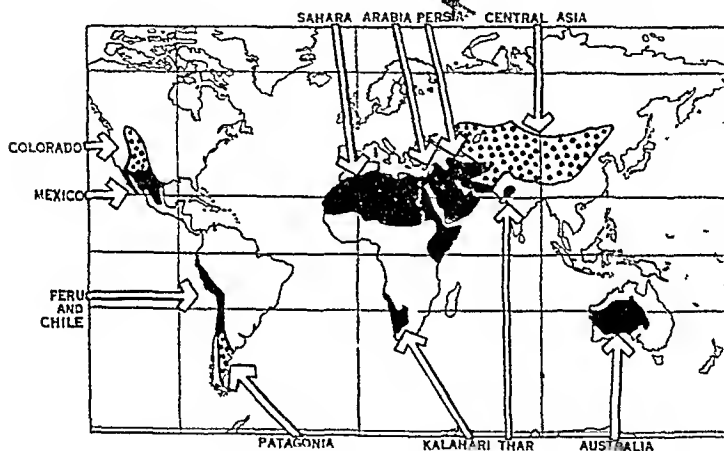


FIG 86 —Map showing the Hot and Temperate Deserts and Semi-Deserts of the world

the Atlantic coast to the extreme east in Egypt. This great desert is continued over most of Arabia and into Persia, and finishes in north-western India. There are large deserts, too, in the same latitudes in North America. In South America the very long narrow desert between the Andes mountains and the sea occupies northern Chile. In South Africa there is the desert of the Kalahari, and in Australia there is the great dry heart of the whole continent. We cannot really draw a line on a map and say that is really where the desert begins, for on each of its margins

the desert naturally fades into more fertile regions. On the side nearest the equator we have already seen that there are the great tropical grasslands. About 20 inches of rainfall a year is the least that is required for cultivation in the tropical grasslands, and so where the rainfall drops below 20 inches in a year the tropical grasslands fade gradually into the deserts. On the other margins, away from the equator, in the same way the Mediterranean regions fade into the desert. It really requires about 8 or 10 inches of rainfall a year as the least that is necessary for cultivation to be possible. So that where the rainfall drops below this the Mediterranean woodland fades into the desert. But over large tracts of the deserts there are a few tufts of grass and bushes, sometimes a few spiny plants which store up water in their own fleshy tissues, and because of this slight vegetation it is possible for animals, and even for man, to exist in the desert. So let us look first of all at the people who live in desert regions. We can say that there are really three groups of people. There are, first, the wanderers, or nomads as we call them. They are able to wander about across the desert because they have as their animal the camel, which, as you know, is often called "the ship of the desert." The camel is able to go for long periods without water and has broad, flat feet which do not sink into the sand, and it is able, too, to carry very considerable burdens. You must not think that all the deserts of the world consist of sand. Many of them are rocky deserts, or have a hard surface, so that it is possible for the hardy donkey or mule to be used as a desert transport animal. In modern life, too, there are many deserts that can be crossed by motor cars. There is no need to build roads: the motor cars can be taken straight across the desert, except where there is soft sand. Amongst the nomad inhabitants of the desert are many of the Arabs who live in the Sahara. They act as carriers, and often bring goods from one side of the desert to the other. You have probably all heard of Morocco leather. It is called Morocco leather because we get, or used to get, our

supplies from Morocco, which is a Mediterranean country on the northern side of the Sahara Desert: but, actually, that Morocco leather was made round about Timbuctoo, in Nigeria, and had been brought right across the desert in these desert caravans of camels. When times are hard these desert wanderers sometimes turn into bands of robbers. Then in the second place, there are the people of the desert who live in the oases. An oasis is a fertile spot in the desert—sometimes only a very small tract,



[Photo L. D. Stamp

FIG. 87—A view in a rocky desert

sometimes quite a large area.] If there is underground water near the surface trees, such as the date palm, will grow, and it may even be possible to cultivate crops or to keep animals, and on an oasis of the larger kind many people are able to live, such, for example, are found in the great heart of Arabia. One of the most important crops, very largely used for food by the desert dwellers, is the date which grows on the date palm. Then the third group of people who are desert dwellers are those who go

there because they wish to work the mineral riches. Some of the deserts of the world, as, for example, in Western Australia, contain great gold deposits. Then there are desert districts, as on the coast of Egypt and in Persia, where there are great oil fields, and in order to obtain the gold or the oil or the other minerals, towns are built in the midst of the desert, although it may be necessary to carry to those towns every drop of water required and, of course, every particle of food. There is one interesting mineral deposit which is found in the desert of northern Chile, and that is a mineral called nitrate. It is very largely used for fertilising the soil. Now nitrate is very valuable, and if there were any rain in that region the nitrate would all have been washed away long ago; so this valuable deposit is only left there because the land is really a desert. In North Africa, running through the desert there is that famous river, the river Nile. This river runs in a valley about 10 miles wide between two high lines of cliffs. The river overflows into this narrow valley, and so it enriches the desert soil with silt brought down by itself, and it also moistens the soil, with the result that the Nile Valley in Egypt is very fertile. You can really think of it as a very long, big oasis by the side of the river Nile which is made fertile by the waters from the river. Thousands upon thousands of people live in this tract and produce large quantities of fine quality cotton, as well as many food crops.

Cool Temperate, or Deciduous Forest, Regions

We must now leave the tropics and the warmer temperate regions and see what happens in the cooler parts of the temperate regions. Let us first take lands which lie near the ocean on the western sides of the continents. You remember that on the western sides of the continents nearer the equator we found the Mediterranean lands. As we go northwards from these Mediterranean lands we find that we get the regions where the westerly winds are blowing

throughout the year. That is to say, there are comparatively warm moist rain-bearing winds blowing from the ocean at all seasons of the year. The result is that these lands have rain coming in every month of the year and usually there is not much difference between the amount received in winter and summer, perhaps a little more in the summer. The winters never get very cold—they are, as we say, mild, but the summers, because of the then cooling winds from the ocean, are never very hot. The winds

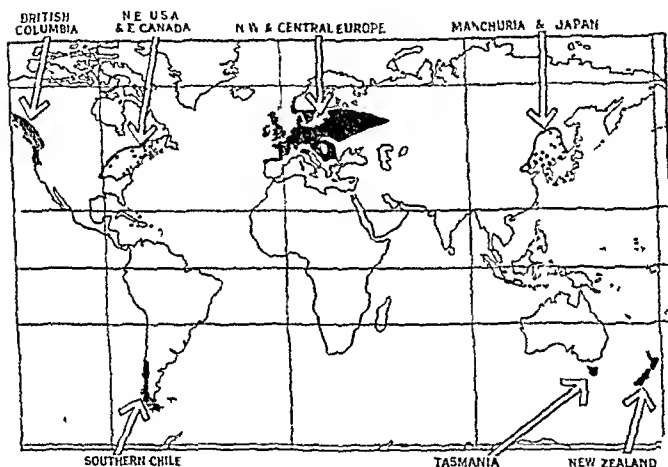


FIG. 88 —Map of the world showing Cool Temperate Deciduous Forest regions (in black)

do not blow constantly, but rather as a succession of cyclones and anti-cyclones, about which we have talked before. We need not say very much more about the climate of these lands because the British Isles give us a very good example. We all know what happens in this country. We have a great many cloudy-days because of the clouds that are brought from the ocean, and we never know from one day to the next when it is going to rain, but we do not often get long periods in the winter with snow and ice,

but only a few days together. And in the summer we do not often have long spells of great heat, but only for a short time. Because there is plenty of moisture, trees grow well in this type of climate. We find that they usually take their resting period in the cold winter, and so our typical English trees, such as the oak, shed their leaves in the winter time. In the spring they have their fresh new crop, which they keep on during the summer, and then the leaves turn colour and fall again in the autumn. Where the trees have been cleared away grass grows very well, and because it is damp throughout the year the grass always remains green, it even grows a little bit in the winter time. These damp pasture lands are very good for cattle, for cattle like the rich green grass, and there is the great advantage that they can be kept out of doors throughout the year. We have, in this country, a great deal of dairy farming, as well as the rearing of cattle for the production of beef. On hill slopes, where the drainage is good but the grass shorter and poorer, there are sheep pastures, whilst in all the richer lands (provided it is not too wet) cultivation is possible. So mild are the winters that it is possible to sow some of the seed—for example, the winter wheat, as we call it—in the autumn. It stays in the ground during the winter and then in the spring grows rapidly. In a very cold country it would be damaged, probably even killed, by the hard winter frosts. There is not very often the danger of drought or absence of rain, the chief danger is that in the summer there may not be enough sunny weather to ripen the crops, and sometimes the farmer is complaining that his crop of wheat or oats is ruined because it has not been able to ripen—there has not been enough sun. The climate of this country is really a very good climate for men. We often grumble about our long winter, but it is really a healthy climate. It is never too hot in the summer for us to work, and it is not necessary for us to have an afternoon sleep, or a siesta, as people do in Mediterranean countries. Instead of that we can work all through the day. Then in the winter time it really is rather nice to do some hard work

in order to keep warm. So we find that manual labour—work that we do with our hands—can be carried on throughout the year. ✓ Let us look for a moment where we find the lands with this type of climate. There is the whole of north-western Europe, including the British Isles, and part of France, Belgium, Holland, and part of Germany, as well as Denmark and the coastlands of Norway. As we go eastwards so we are getting towards the interior of the great continent, which as we have learnt several times already gets extremely cold in the winter. So we find as we go eastwards in Europe, into eastern Germany, Poland and Russia, as well as into central Europe and Southern Sweden, winters are much colder than they are in England. This is sometimes called the central European type of climate. It is really only a little different from ours, with its colder winters when sometimes the ground is frostbound for weeks together, and with its summers which are usually a little hotter. Then in North America, in the same latitudes, there are the north-western United States and the great province of British Columbia in Canada with this type of climate. § Another region is the extreme south of Chile in South America, but this, unfortunately, is not a very good region because it is very mountainous and it gets far too much rain. The high mountains attract a very heavy rainfall of 100 or 200 inches a year, and so with the small amount of flat land and the very great amount of moisture it is really too wet for settlement and cultivation by man. We notice that this type of climate does not occur in South Africa, for the continent of South Africa does not extend sufficiently far south. * The same is really true of Australia, but there to the south of Australia the island of Tasmania which has this type of climate, and so also has the important country of New Zealand. ✓ If we look again at Europe we can tell that this climate has been most favourable to man because the great manufacturing countries of Great Britain, France, Belgium, Holland and Germany are all situated in tracts having this type of climate. / To these we can add those

which have the central European type of climate, such as Czechoslovakia and Poland

The Temperate Grassland Regions

We have just seen that as we go eastwards in Europe from the British Isles, farther and farther away from the ocean, the winters get colder and the summers rather hotter. If we go still farther towards the interior of the

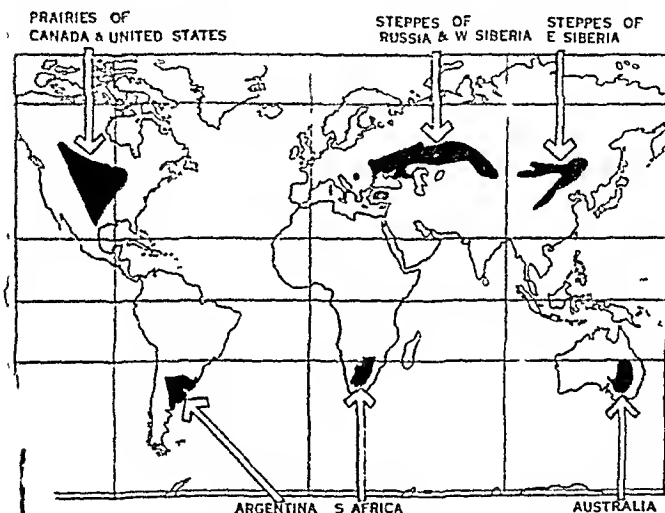
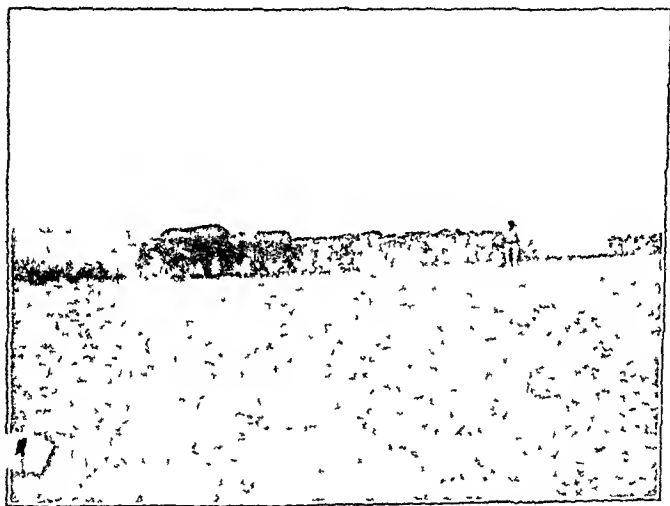


FIG. 89 —Map of the world showing the Temperate Grassland regions

great land mass we come to regions where the winters are extremely cold, where the rivers are frozen over for many months together and where the ground is frozen hard to a depth of many feet. Here nearly the whole of nature must take the long winter rest; plants cannot grow, and they must all wait for the coming of the spring. With the coming of the spring and the warmer days the ground thaws and the snow, which may have fallen during the

winter, melts, and so with the warmth and moisture the ground springs into life and the grass grows up rapidly. Because the interiors of the great continents get very hot in the summer these regions have a very hot summer. Grass grows up very quickly and the seeds are formed, and in the latter part of the summer it may be so hot and dry that the whole surface of the country becomes dry and brown with the withered grass. This is not the sort of climate suited to the growth of trees, for the trees would have to have very long roots to get down to the moisture during the winter, and the long, hard winter would not suit them, and trees cannot grow rapidly enough to take advantage of the spring rains and the melting snows. We find, therefore, that the interiors of the great land masses of the Northern Hemisphere—that is, in Eurasia and North America—are the great temperate grasslands of the world. They are called prairies in North America, but steppes in southern Russia and in southern Siberia. On the steppes there live those animals which feed on the grass, and which, as we saw in the tropical grasslands, are animals which take a hasty meal and then move off to some quiet spot to chew it over again—chew the cud—mostly animals swift of foot so that they can escape quickly from their enemies. It has been found that the wild horse and the wild ass of the steppe lands of Mongolia can travel over 40 miles an hour. Then there are the carnivorous, or flesh-eating animals, which live on these and chase them. In the days of old, man himself was a hunter in these regions. You have all read stories of the Red Indians of North America, what fine horsemen they became, how they hunted the great herds of buffalo and bison which were once abundant on the North American prairies, but which have since almost disappeared. On the steppes of Russia there were the Cossacks who likewise were fine horsemen and hunters. Then came the next stage of the early settlers in the prairies of North America, the early white men, who became cowboys and looked after great herds of cattle. Man had become a pastoralist. Similarly, on the steppes of southern

Russia great herds of cattle and even sheep were kept, but the great temperate grasslands of the Northern Hemisphere—the prairies and the steppes—are fast being converted, and have, in fact, been almost converted into enormous stretches of arable land. For where natural grass grows well surely grasses cultivated by man, such as wheat and oats and barley will also flourish. So these grasslands of the Northern Hemisphere have now become



[Photo S African Railways

FIG. 90.—Ploughing on the "High Veld" or grasslands of South Africa

the great granaries of the world. Canada is the largest wheat exporting country in the world, and the production of wheat in the same areas in the United States is likewise enormous. So, too, there are the enormous grain growing areas of southern Russia. But the wheats grown are of a different character from those grown in England, or even in Mediterranean lands. They cannot be sown in the autumn, as they often are in England; they have to be

sown in the spring, and so they are known as spring wheats. If we turn to the Southern Hemisphere we find that the continental masses there are very much smaller, and so do not become so cold in the winter time, but there are regions in just the same way which get a light rain in the spring months and rather a hot summer, and although the winters are not so cold, there, too, are grasslands as in the Northern Hemisphere. We have the grasslands called the pampas in the Argentine, in South America. the grasslands

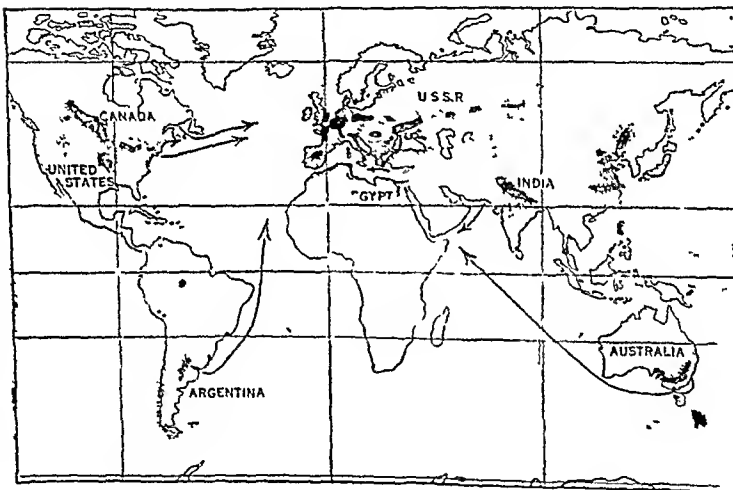


FIG 91 —Map showing the great wheat lands of the world.

on the high plateau in South Africa, and the grasslands in the basin of the rivers Murray and Darling in Australia. Because of the comparatively mild winters animals can be kept out in the open throughout the year, and so we find that these are very important regions for the rearing of sheep and that three of the great wool exporting countries of the world are the Argentine, Australia and South Africa, the wool coming from sheep kept on these temperate grasslands. Then, too, the pampas of South America,

and the downlands, as they are called in Australia, have become very important growers of wheat and other cereal crops. The cereal crop which is grown on these lands in South Africa, where it is rather warmer, is maize. But look now carefully at the map showing the distribution of the wheatlands and the wheat exporting countries of the world, and you will see how closely they coincide with these great temperate grasslands. Nearly all the grasslands have been developed in comparatively recent years. In Canada great cities have sprung up in a few years. Winnipeg, the largest of them all in Canada, was founded only about 60 years ago, and it is now a great city of over 200,000 inhabitants.

The Temperate Deserts

Most of the things that we said about the Tropical deserts apply also to the Temperate deserts. As we get towards the interior of the great continental masses in the Northern Hemisphere, we find that the land becomes drier and drier and the Temperate grasslands fade into Temperate deserts. Where the rainfall is less than 8 or 10 inches it is not possible for grass to grow properly or for man to grow crops. The Temperate deserts vary greatly in character. Some of them occupy plateaus at a great elevation above sea-level, such as the great plateau of Tibet, other parts of central Asia are not at such great elevations above sea-level—for example, Mongolia—and they have a climate which is somewhat different. Similar Temperate deserts occur on the plateaus amongst the Rocky Mountains of North America, and when we come to the Southern Hemisphere we find the great shingle desert of Patagonia lying to the south of the pampas, or grassland region. But again we find, as in the Tropical deserts, a few people who eke out an existence by wandering about, a number who live in the more fertile valleys that can be irrigated and really correspond to the oases, and there are, of course, people who here and there go to exploit the

mineral resources that are found in the Temperate desert tracts (For map, see Fig 86. dotted areas)

The Cool Temperate Regions of the East Coasts

When we were considering the warm temperate regions we found that there was a great difference between the climate of China on the one hand and the climate of the south-eastern United States on the other. Similarly, when we consider the climate of the extreme north of China and of Manchuria, and the neighbouring coastlands, we find that there is a great difference between that tract and the region which occupies a corresponding position in the North American continent, namely, the north-eastern United States and the St Lawrence region of Canada. In Manchuria we find extremely cold winters, because of the winds which blow outwards from the great cold heart of Asia in the winter time. Naturally, also, this country is practically rainless at that time, and so we get conditions which are not very unlike those of the great grasslands. In the summer, when the interior of Asia becomes heated the winds blow in from the ocean and bring with them the monsoon rains, and so we get a region of summer monsoon rains, but with extremely cold winters. The centre of Manchuria is a grassland rather like the prairies of Canada, the hills on either side of the central plain are forested with a mixture of coniferous and deciduous trees. It is a region, still only partly developed, capable of producing over large tracts any of the crops of Canada, and capable of producing from the hills large quantities of timber.

In North America the north-eastern United States and the neighbouring provinces of Canada form an extremely important region. They have a very cold, almost an unpleasantly cold, winter, with the average temperature going below freezing-point for several months of the year. The summers get hot, even unpleasantly hot. The characteristic of this region is that the rainfall or snowfall is well distributed throughout the year, that is because the

are in Canada particularly, in the North American continent; in Norway and Sweden, Finland and northern Russia, in Europe and in the great belt across Siberia or northern Asia. We are really using up the reserves of timber and the world at a very serious rate, and soon the countries that will have any large



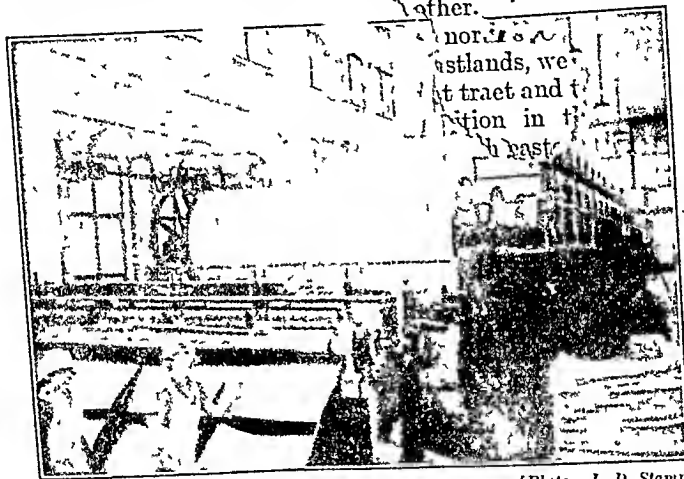
[Photo L D Stamp]

FIG. 93.—A typical Coniferous Forest in summer (Finland)

quantities left will be Canada and Russia. We see then that one of the great activities of man in this region is in working the forests. Another activity is in hunting the fur-bearing animals, for in regions that are cold for so much of the year the animals, particularly the wild animals, have to protect themselves against the cold by a thick coat.

THE REGIONS OF THE WORLD

These coats furnish us with the materials for furs which we largely use for clothing. Although a great many of the fur coats worn nowadays are made from rabbit skins, a very large number are from skins of animals found in the northern coniferous forests, and many of the people who wear fur coats to realise that great difference in the warm temperature of the warm temperate zone and the cold of the northern zone.



[Photo L. D. Stamp]

FIG. 94 — Inside a wood pulp and paper mill

regions is a very important industry. Although both the timber working and the fur industries are important, there are not really many people living in these regions. That is because it is really too cold for much agriculture to be carried on. The summer is too short or too cool, for example, for wheat to ripen; but in these northern regions the summer days are very long, and, indeed, you know that when we get to the Arctic Circle there is at least one day in the year on which the sun never sets and at least one day in the winter on which the sun never rises. The weather is